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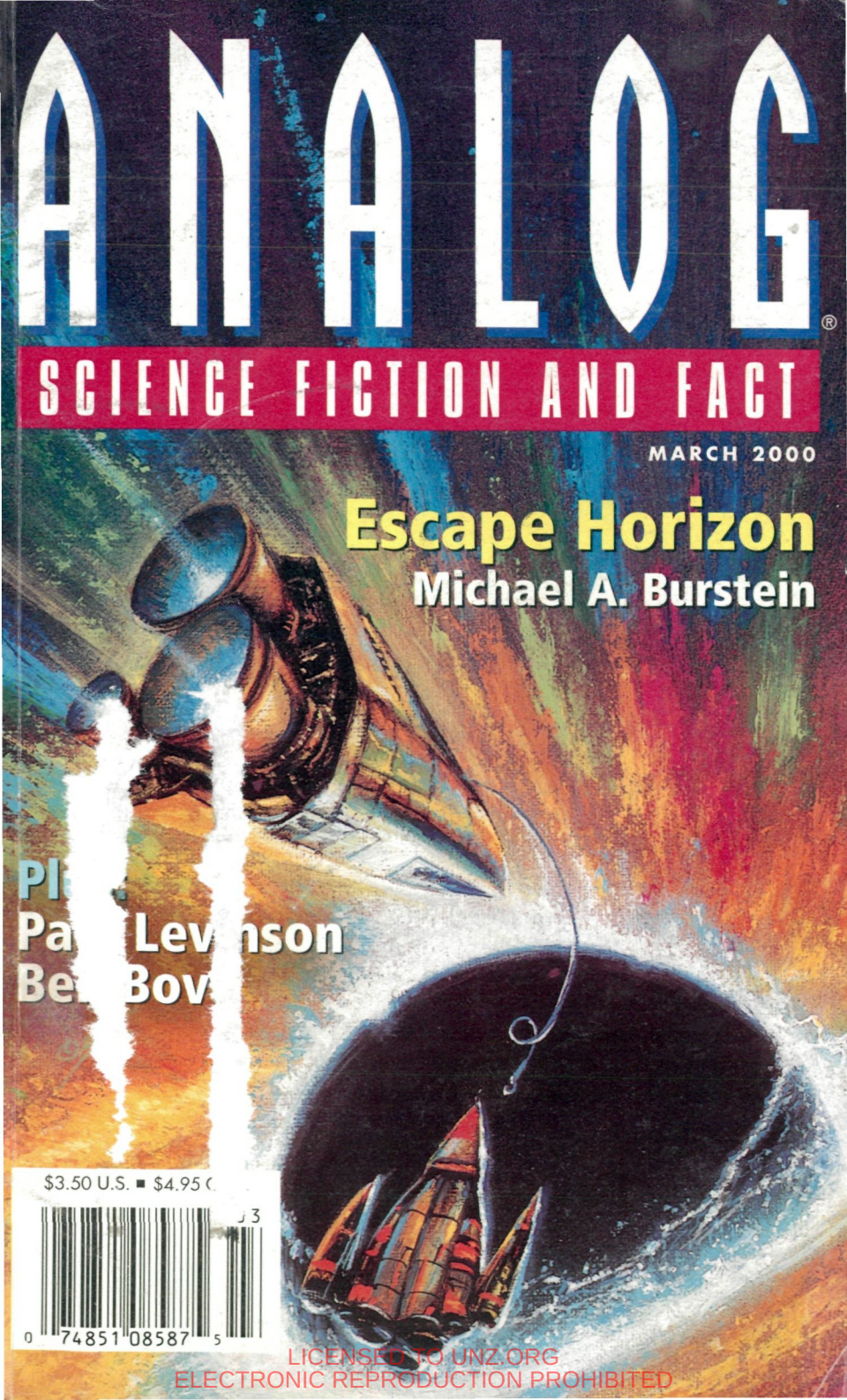

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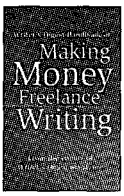

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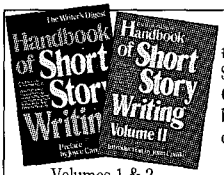

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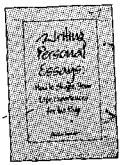

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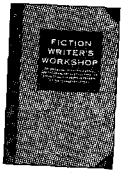

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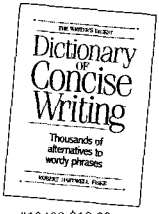

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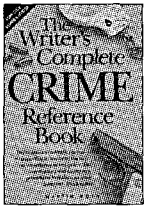

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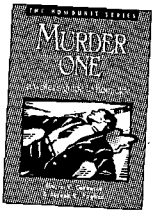

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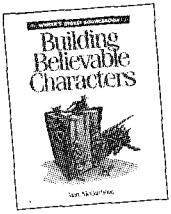

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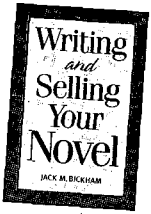

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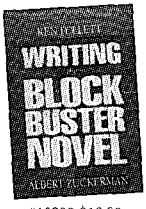

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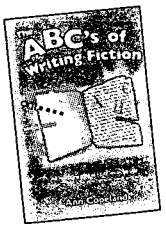

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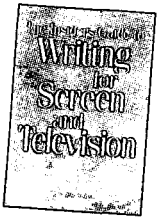

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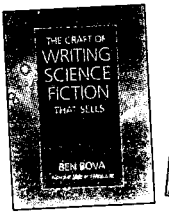

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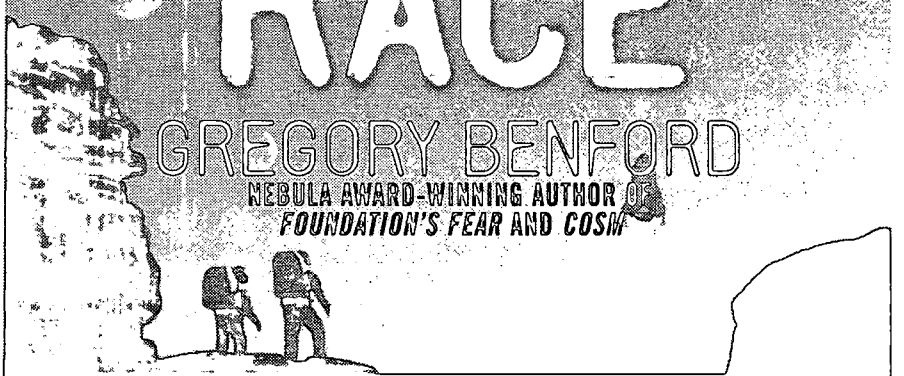

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EDITORIAL Stanley Schmidt

THE RED QUEEN'S RACE

We've often heard that a little learning is a dangerous thing. When is a *lot* of learning a dangerous thing?

Well, consider a recent Gannett newspaper article headlined, "'Lifelong Learning' key to new workplace." The gist of it is that with the current pace of technological change in general, and its application to business practices in particular, "lifelong learning" has now become, and will remain, the norm for most people.

Far be it from me to deny the value of lifelong learning, or to discourage anybody from doing it. I try to do lots of it myself, from keeping up with new developments in a variety of sciences, to learning a new language every few years whether I need it or not, just for the fun of it and to keep the mental muscles limber.

But there's lifelong learning and there's lifelong learning. The kind I'm describing, which I do by choice, is learning about things that interest me—and, in many cases, things that I didn't have time for when I was a student in formal academic programs. I look forward to doing even more of that in some distant time after I retire from formal employment, and I expect to continue as long as I am physically and mentally able.

The Gannett article (which is merely one of many examples I could have cited) was talking about something entirely different. It was referring to the current tendency for the nature of jobs to change so fast that people must keep going back to school just to keep them—or to move into new jobs when the old ones become extinct. It quotes David Boykin, a bank vice president and author of a book on "career management strategies" as saying, "As your industry changes, you don't want to stay stagnant. You want to be able to say, 'OK, within the last 12 months I've taken these five courses, which have enhanced my skills fivefold. . . .'"

But the truth is: no, I don't. I'm willing to confess it, and I'll bet a lot of other people don't want that, either. I realize a survey cited in the articles indicates that a large percentage of workers consider employer support for employee education an important benefit, and an even larger percentage say they would take courses if their employers picked up the tab. Some of those workers, no doubt, really *want* to take more courses for their own sake. But many more, I'd be willing to bet, want to take them only because they see doing so as the only way to improve, or even maintain, their current material standard of living.

In other words, they've been forced to run a race like that of the Red Queen in Lewis Carroll's *Through the Looking Glass*:

> "Well, in *our* country," said Alice, still panting a little, "you'd generally get to somewhere else—if you ran very fast for a long time, as we've been doing."
>
> "A slow sort of country!" said the Queen. "Now, *here*, you see, it takes all the running *you* can do, to keep in the

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same place. If you want to get somewhere else, you must run at least twice as fast as that!"

Our culture increasingly resembles the Red Queen's country. Some people share her royal tastes, and thrive on the constant stimulation of trying to get ahead in a world where they must run like crazy just to keep from falling behind. And they leave little room for those who, like Alice, would be content to stay where they are, at least for a while. Like it or not, they must run like crazy, too.

That, I think, is a downside of progress—or rather, of the kind of progress that drags everyone along at a pace they find uncomfortable. Personally, I wouldn't like to see things stay the same through my entire life; I enjoy the excitement of new frontiers and the convenience of improved ways of doing things. But I also think we all need an occasional breather to reexamine the question of what all this is *for*. Do we want to rush headlong to embrace whatever change comes along? Or should we be a bit more selective, adopting changes that help us do better what we want to do, and rejecting ones that don't?

Those questions aren't nearly as simple as they may sound, especially when you consider the widespread human tendency (even among science fiction people!) to resist change before it happens, and to consider it welcome and inevitable afterward. One of this magazine's earlier publishers, for example, evoked lots of groans among the staff of many magazines when it decreed that it was going to sever ties with its typesetter and convert the whole operation to desktop publishing. But few, if any, of the staff who lived through the change would now want to go back to the old ways.

And yes, the transition did require a fair amount of reeducation. But now that it has been made, things have settled into a new kind of quasi-stability, and nobody is in any hurry to go through another change of comparable magnitude.

The danger I see in the "lifelong education" trend, especially given the rapid *acceleration* of technological change and some people's compulsion to keep up with it no matter what, is that we may be drifting toward a situation in which most people are *constantly* undergoing the stresses of transition, and *never* get out of school except for the occasional brief interlude. If I've taken five courses in twelve months, as Mr. Boykin suggests, and there was anything to them, I've been *busy*—quite likely so busy that I've had little time to do anything else except that and work. When huge amounts of people's time and energy are forced into continuing education just to stay employed, there's little left to learn things just for fun or interest. (Or even to learn *nothing* if one chooses to do so occasionally. Every waking minute does *not* have to be pro-

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ductive! As Cicero said Way Back When, "He does not seem to me to be a free man who does not sometimes do nothing.")

One Carolyn Wells once observed, "We should live and learn, but by the time we've learned it's too late to live." What she had in mind, I suspect, was that living with attention to everything that happens to and around us will teach us lessons that can help us live better, but by the time we've learned enough of them to cover most situations, most of life has gone by. How much worse does that problem become when people are compelled to spend so much time learning to *work* that they have none left to learn to *live?*

Which leads us back to the central question: do we work to live, or live to work?

I realize that in some cases employers not only subsidize the monetary cost of additional training, but treat it as part of the employee's job, letting it be done on company time rather than gobbling up family or private time. I applaud these employers; they're doing what they *should* do when their employees need new skills. But I also realize that many employers do *not* do that, and many employees feel compelled to take courses on their own time and at their own expenses for their employers' benefit.

Things do change, and often for the better. In a great many ways, we are far better off than our ancestors, and if we proceed with care and good judgment, we can probably help our descendants to be even better off. But the key words are care and good judgment. Not all changes are equally beneficial or desirable, and both individuals and societies have to make choices about the ones they want.

The difficulty is that societies are a lot bigger than individuals, so individuals often have choices forced upon them. Changes of the magnitude of mass production, airplanes, radio, and computerization do require people to change their ways and learn new skills, but when a field is evolving very rapidly, there's a tendency to rush headlong into adopting every new change that comes along—even if it means forcing other people into an endless Red Queen's Race of reeducation.

Suppose a computer consultant in 2000 comes to a company, looks over its facilities, and says, "My goodness! You're only up to 1997 standards. Well, we'll fix that. . . ." The common response is to follow his advice with little or no ques-

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tion, plunging into a frenzy of "upgrading," disrupting work routines while new hardware and software are brought in to replace old, and workers divert time and energy from their normal work to learn how to use the new stuff. It's usually at least a little traumatic and exasperating, but when it's done, they're much better off than before. . . .

Or maybe they're not. Sometimes an upgrade is really needed, and sometimes it's a complete waste of time and money. If much of your work involves extracting information from large databases that take half an hour to search with an old machine, a new one that can do it in a minute is a highly worthwhile investment. If you're competing with somebody else who does the same thing and has the new machine, you *need* one, or you'll soon be out of business. On the other hand, if all you do is word processing on small to moderate-sized documents, the slowest system you can buy is still so much faster than you are that it spends most of its time waiting for you to do something. Even a much faster system will make no noticeable difference in what you can do.

So when your consultant tells you you need to upgrade to state-of-the-art because you're three years behind, the appropriate response before doing so is to ask, "So, what is this keeping me from doing that I need or want to do?" If he has a good answer, *then* go ahead with the upgrade. If he doesn't, save your money and let your workers keep doing their jobs.

My personal criterion for whether to upgrade software or hardware is what my brother (who is a professional programmer) calls the "bumping-my-head" test: if I'm bumping my head too often, I raise the ceiling. That is, if I find myself wanting to do things that are too difficult or time-consuming with my old equipment, I buy what it takes to eliminate the problem. If I haven't experienced a problem, I don't spend time or money on unneeded "solutions." But that's a distinctly minority view. Much more common seems to be the attitude, cheerfully encouraged (for obvious reasons) by computer manufacturers and salespeople, that you've just Gotta Have the latest thing, whether you need it or not.

I would never suggest that any business or individual should expect to keep doing things the same way forever. I've remarked many times myself that no one can count on having the same career for an entire lifetime, much less doing it with the same equipment and without learning any new skills. But there's a lot of room between that and having to *constantly* take courses or other types of formal training (or, worse yet, adapt to new systems with *no* training). There may be people who like taking courses so much that they'd like to keep doing it forever, but I was never one of them. I love learning, but for me, formal courses were seldom either my favorite way of doing it or the way that worked best. And high school and college consumed a *huge* amount of my time. (I once heard a fellow student refer to students as "America's largest leisure class," but then, he flunked out.) I endured it because I saw it as a means to an end: a way to reach a point where I could spend a significant part of the rest of my life doing (and learning) things that I wanted to do rather than things that other people wanted me to.

And there, I think, is the answer to my opening question. A lot of learning is a dangerous thing when it's learning that you must do for someone else's benefit, and it goes on and on and prevents you from learning (or doing) much for your *own* benefit. Our culture seems to me to be letting this danger become all too prevalent, and urgently needs to find ways to head it off. I don't have easy answers for how to do that, but a good start would be to get a lot more people asking, "Am I bumping my head?" a lot oftener—and insisting on good answers before plunging ahead with "solutions" that may not be needed.

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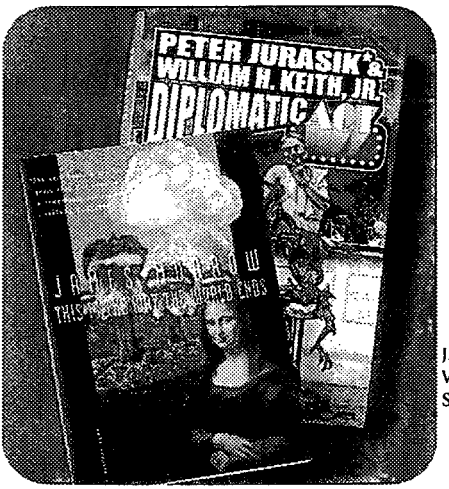

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That, of course, would be the beginning of a pervasive philosophical change, and it might well go considerably further. That Gannett article mentioned a 54-year-old worker who could remember "when it took 30 people to perform the job one person can do now." I can understand an employer's temptation to expect that one person to do the work of 30. But with the same technology and more thought to which jobs are really necessary or worthwhile, might it not be possible to have each person do the work of *15*, in half the time it would take to do the work of 30, and maintain just as good a standard of living—with a lot more time to enjoy it?

If so, *everybody* would be better off—and we could let the Red Queen go on her merry, futile way, without feeling obliged to "keep up" with her.■

IN TIMES TO COME

Analog doesn't do very many "alternate history" stories, for the simple reason that while a speculation on, say, who won a particular election may be fascinating, it does not seem a sufficiently radical change in the world to constitute science fiction in the fairly strict sense that we try to use the term. There are, of course, notable exceptions, such as Harry Turtledove's "sim" stories (which became the novel *A Different Flesh*), exploring how the whole world might have been different if *Homo erectus* colonized the Americas but *Homo sapiens* didn't. Next month, in our April issue, we're delighted to present an equally unique alternate history novella, "Obsidian Harvest," which its authors, Rick Cook and Ernest Hogan, have called a "dinosaur-Aztec-detective story." I'll leave it to you to try to guess exactly what they mean by that, and what assumptions they made to derive their alternate world, but I think you'll have a lot of fun finding out when you read the story!

We'll also have a new novelette by Michael F. Flynn, and two seasonally appropriate items: Shane Tourtellotte's "The Virtual Congressional Caucus" (it's primary season, right?) and James Van Pelt's "The Comeback" (it's also baseball season, or soon will be).

Last but not least, Dr. H. G. Stratmann takes a detailed doctor's-eye view at that old science-fictional standby, suspended animation. It's relatively easy for writers to imagine what such a process might mean, but a bit harder to actually make it happen!

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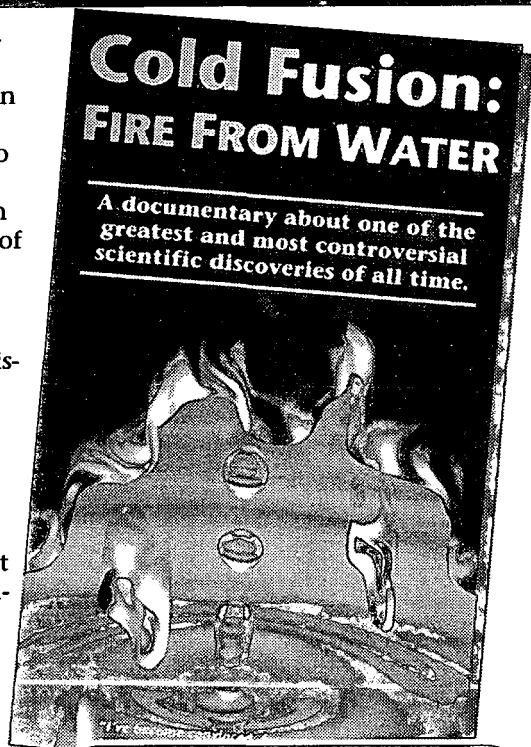
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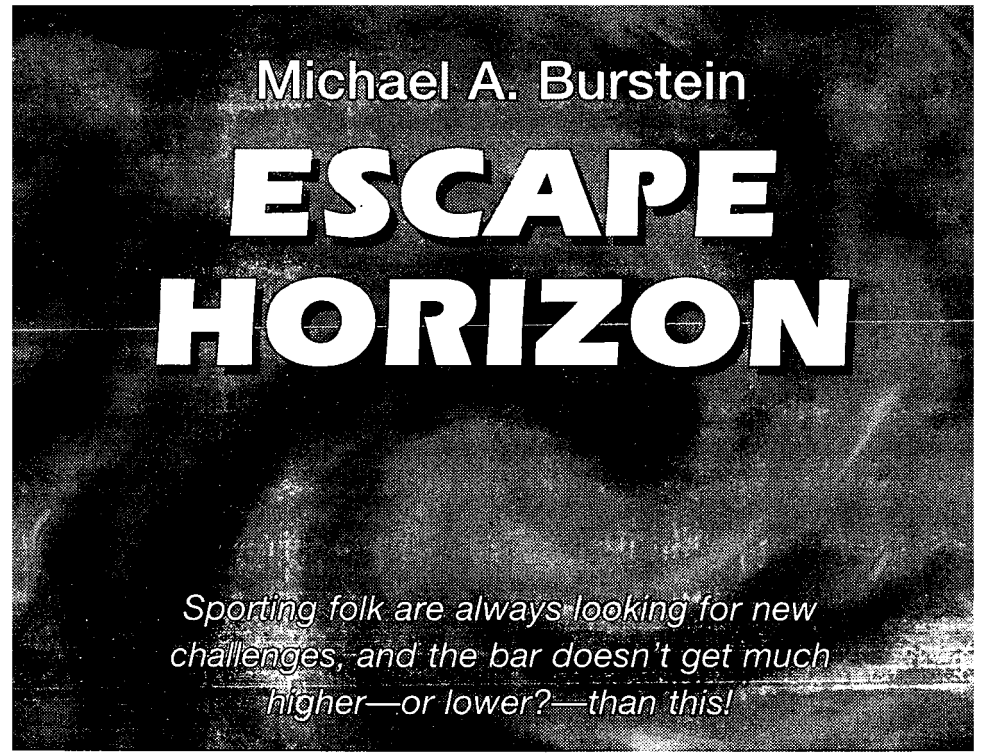
Michael A. Burstein
ESCAPE HORIZON
Sporting folk are always looking for new challenges, and the bar doesn't get much higher—or lower?—than this!

The black hole and its glowing accretion disk filled my viewscreen. Like a gaping mouth, it dared me to come close, begging for its meal. An odd image to put on my viewscreen, perhaps, but it calmed me down a lot more than the Championship Dive precontest interstellar broadcast I had been watching. Staring directly into the black hole, the quiet peacefulness I imagined inside helped relax me. I knew it was all my imagination, of course, but it worked, as I knew it would. I'd been in this position many times before.

Just as I was in a state of utter relaxation, the radio beeped. I toggled the switch to answer it. "Base One, Carrus here. Over," I said, just as I realized that I was incorrect.

"Hi, Ilona! It's not Base One."

I smiled; leave it to Damon Adlus to figure out a way to hack into the radio system and get in touch. "Hi, Damon. What's down? I can't talk for too long."

He laughed. "Neither can I, obviously. They're going to start the contest any minute now. I just wanted to say—well, it's been an honor competing with you. You're the best I've ever competed against."

I nodded, although he couldn't see me. I was grateful for that, because I could feel myself getting choked up, and my eyes began to water. Damon was the champion for three Earth years in a row, and his call made what I was planning feel even worse. "Thanks, Damon. I feel the same."

"Second best of luck, Ilona." That was an old joke among divers; after all, none of us wanted the others to have the best of luck, obviously.

"Second best of luck, Damon. Carrus out."

It was still hard for me to believe I had made it this far. But, over the past Earth year, I had risen in the ranks, won every dive competition I had been in, and

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earned myself a position in the Championship. I had never expected to win even one competition; when I started diving, it was just as a lark. I was taking time off from my piloting job and thought it might be fun to put my skills to a different use. Look where it got me.

With Damon's interruption over, I looked back at the black hole on my viewscreen and studied it in an attempt to calm myself down again. Unfortunately, I started to think about the contest and its physics even more. Space and time do weird things near a black hole, even a normal one. Everyone knows that the closer one gets to a black hole, the stronger and more intense the gravitational field becomes. What people forget about, though, is that the *differential* also increases, making the gravitational field change strength over incredibly tiny distances.

In other words, the tidal effect is so strong that long before you got too close, the difference between the pull on your feet and the pull on your head, assuming you dove in feet-first, would be enough to rip your body to shreds.

A normal ship hull wouldn't be able to handle such stress, but we weren't using normal hulls. The hulls were provided by the Pookrah, of course; human technology may have broken the hyperspace barrier, but we still had no idea how to keep out the gravity of anything as intense as a neutron star, let alone a black hole.

Of course, what we were diving close to wasn't a normal black hole, but a rotating black hole, sometimes known as a Kerr black hole for the scientist who first worked out the theory behind it. This was the Championship Dive, after all. The judges figured that the rotating space-time would make things even harder—

The radio beeped again; it still wasn't Base One.

"Bleen to Ilona Carrus. Come in, Carrus."

Was everybody managing to break into the circuits? Only Base One was supposed to be able to reach me. Sighing, I toggled the switch. Bleen must have been better than Damon at this, because his image came up on the secondary viewscreen, and it was obviously him. The Pookrah are taller and thinner than we are, with nostril slits instead of noses, aural holes instead of ears, and wider mouths. The greenish tint to their skin always reminded me of reptiles. I knew some people who couldn't stand their odd appearance, but to me their looks seemed close enough to human that I never gave it a second thought. Also, as a pilot I was constantly in contact with Pookrah, and their mannerisms were so close to our own that I eventually got to thinking of them as just another race of human.

"Bleen, get off this frequency. If Base One knew we were in contact—"

"I *am* on Base One, Carrus. And there is no need for alarm. The channel is secure."

I sighed again. "I'll take your word for it. What do you want?"

"I've invested a lot of time and money into the Imalium. I just wanted to confirm with you that everything was set for today's contest."

"Yes, it's all set. Everything's set." I allowed myself the luxury of a wide smile. "No one knows that you've provided me with the hull. As far as they're concerned, it's just regular Pookrah-provided Tourtellium." I paused. "I still feel a little weird about this, like we're cheating."

"You saw the rules yourself. There is no rule against using a hull made of a different material."

I laughed. "That's because no one in their right mind would use a different material! The ship would be torn to pieces."

"But not in this case, Carrus. That is the whole point of the exercise."

I nodded. "And the exercise will go well, Bleen." I thought for a moment,

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then decided to express my appreciation one more time. "Thanks for choosing me to be the one."

He looked down, then up, the mannerism the Pookrah used for a shrug. "No thanks are necessary, Carrus. You earned it by your record."

I felt my face turn warm. "Thanks, Bleen. I'll see you afterwards."

He signed off with the usual phrase spoken by nondivers to their diver friends. "May your trip to the event horizon—be uneventful."

Of course, neither Damon nor I would get to reach the *actual* event horizon. After all, that's where light gets trapped in a circular orbit, and neither of us could move faster than light. Even the Landis hyperdrive doesn't work so close to a black hole.

What we were trying to do was skirt something else, which we usually called the "escape horizon." Both ships had the same mass and same maximum speed, so both ships had the same effective orbital radius from the black hole. That radius would be the distance at which either ship would just barely miss being ripped apart by the tidal forces. Sometimes the commentators would refer to the escape horizon as the radius where the ship would be trapped in a circular orbit, going around the black hole forever, and never being able to break free. But that was nonsense. Anyone who tried to get that close would find their ship ripped apart long beforehand.

So the escape horizon, the way we divers used the term, was the closest distance a ship could approach before the tide ripped it apart. And of course, with my new Imalium hull, clandestinely provided by Bleen, my personal escape horizon would be closer in than Damon's. There would be no way I could lose.

The radio beeped again. Finally, this time, it was Base One, the hyperdrive ship which floated nearby, broadcasting the event via hyperwave radio to all corners of the galaxy. At least, that's how their slogan went.

I recognized the radio technician whose picture came up on my viewscreen from her wide brown eyes and short dark hair. "Hi, Caitlin," I said.

"Hello, Ilona. How's it going?"

"OK, I guess. What's down?"

She rolled her eyes. "Dizzy signaled me. He's getting to the part in the broadcast where he wants to interview you for a few seconds for the viewers back home."

I sighed; I always hated this part. "OK. Patch the broadcast through."

"Here goes. Don't forget that when the red light goes on, you're being seen by trillions of people." She smiled devilishly, but before I had a chance to respond her image was replaced by that of Dizzy Greene. His hair was slicked back, and he was wearing a Pookrah four-horned hat that was supposedly becoming very popular with the teenagers.

I've always hated the commentators for the dives. They tended to pander to the lowest common denominator in their audience—the people who hoped that something would go wrong and that they'd get to see a ship sucked into a black hole. I had always hated that attitude, even when I was a little girl. I still remember watching the competitions eagerly, always rooting for the local diver to win, and never once hoping that something would go wrong.

Of course, the local diver was usually from a planet at least twenty light-years away from my home planet orbiting Upsilon Andromedae, but that was still local as far as I was concerned.

Dizzy was saying: "Ladies and gentlemen, Human and Pookrah, this is the proverbial *it*."

Human and Pookrah? Oddly enough, despite their willingness to provide us with Tourtellium hulls, the Pookrah never paid much attention to the dives. I didn't expect enough of them in today's audience to produce even a blip on the

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hyperwave net. But perhaps Dizzy knew something I didn't.

Dizzy continued: "For those of you just joining us, Ilona Carrus and Damon Adlus, the two divers who have reached the Championship, are getting ready for their final dive." Dizzy leered. "The two of them must be really nervous, eh, folks?"

Dizzy went on to discuss our backgrounds. He started with Damon, the three-time champion who had spent his whole life studying gravity just so he could be the best. Then he talked about me, and how I came out of nowhere, a regular hyperdrive pilot, to rise to the top in my first year of competition. I have to admit that, as I listened, I felt very proud. I had started this Earth year as a nonentity, and I was going to end it as the biggest celebrity of all space-time.

"—so let's find out what they're feeling!" The red light blinked on, and Dizzy addressed me directly. "Ilona Carrus, how are you feeling at this moment?"

I smiled for my fans, while inside I was cursing Dizzy for making me nervous again. "I'm fine, Diz. It's just another dive."

"Just another dive! Folks, isn't that incredible? Ilona, do you want to say anything to the estimated six trillion sentients who are watching this broadcast on the hyperwave?"

I shrugged and tried to sound modest. "I just want to thank everyone for their support. It's been a hell of a ride."

"Thank you, Ilona," he said, and he switched to interviewing Damon. I took a breather, and Caitlin came back on to tell me that things were almost ready to start.

Sure enough, in just a few minutes Dizzy's image was replaced by that of the contest's head judge. The next part was rote, but I could feel myself getting queasy with anticipation. She spoke to each of us in turn.

"Diver Adlus, are you ready?"

"Ready," Damon said, and the judge nodded.

"Diver Carrus, are you ready?"

"Ready," I replied, and she nodded again.

"One, two, three—dive!"

Her image disappeared, and the contest began.

How does one describe what one sees when diving? I know the effects have been recorded in many forms, including virtual, but I've still never experienced a simulation that felt like the real thing. The problem is that the experience is so visual, words tend to fail even a poet. And yet . . . and yet, after having been asked to describe the experience so many times, I felt as if I had finally hit upon it.

The key to the description of what one sees relies on the fact that the closer a beam of light gets to the escape horizon, the harder it is for it to get away. If you were to watch an object break off from the accretion disk and actually fall all the way into a black hole, you would see it get closer and closer but never actually cross the event horizon. That's because the image is made of light, and the light from the event horizon could never reach you. So what you would see is an asymptotic approach; the object would appear to get closer and closer to the event horizon, but never quite reach it. Which further means that it would appear as if time were slowing down for the object, a slowing down which would forever approach, but never quite reach, zero.

In other words, as you dive, you find yourself surrounded by the light echoes of everything that has ever fallen into the black hole. There's one other thing in the universe that traps light in the same way, and it glitters even in a room of limited light.

A diamond.

I was surrounded, as always, by a sea of multicolored light. And not just visible light: my sensors detected electromagnetic radiation from X-rays to radio waves, with everything in between. The light glittered and mixed and danced

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around, and on my viewscreen I saw what I always considered the most beautiful light show the human race had ever discovered.

I enjoyed the picture for a while, all the time thanking God and the Pookrah for the radiation shielding provided by the Tourtellium—no, make that Imalium—hull. But after a few minutes, it was time to get down to business and win this thing.

I started my approach slowly at first. This wasn't a race, so speed was not of the essence. Even if Damon managed to pass me in the first few minutes, that wasn't the point. The point of the competition wasn't to be first, but to be closest.

Slowly, I slid my ship closer and closer to the black hole, keeping my thrusters adjusted properly. I had to be careful of the weird gravitational effects caused by the rotation of the black hole. The Kerr black hole creates a lot of odd effects that you don't find in your everyday, garden-variety black hole. For example, there's an effect called the dragging of inertial frames, which is simply a fancy way of saying that even if you are orbiting around the black hole, you feel as if you are stationary. Admittedly, our ships are designed with artificial gravity, but most divers, including me, always let our ship's interior gravity be affected slightly—*extremely* slightly—by the outside. It gives us an instinct, a feeling of how close we are getting. But with a Kerr black hole, such an effect is nonexistent.

And I tried not to think about the possibility that the ring singularity in the center might throw me into another universe or back in time if I got too close. That was irrelevant, since if I got that close, I'd be dead anyway. Or so the theory went. Best not to dwell on it.

As I got closer to the standard escape horizon for a Tourtellium hull, the warp in space became much more pronounced. The ship's computer warned me about my approach, but as it was calibrated for a Tourtellium hull, I felt little worry about the warnings.

Instead, I piloted the ship closer and closer in, letting my body feel, by instinct, the point at which I thought I passed the old escape horizon. Just for good measure, I let myself drift further inward for a few more seconds before increasing the firepower of the thrusters against the black hole to the point that would keep my ship steady.

Using the computer, I checked my calculations against the warping of space at my location, and I smiled. I had indeed managed to cross the old escape horizon for Tourtellium permitted by the Imalium hull. Even more importantly, Base One had recorded my position, which was confirmed by a ping from their computer system to mine.

The contest was essentially over. All I had to do now was turn around and head back to the station—

—when I saw on my viewscreen that Damon's ship was following the path right behind mine.

"What the hell?" I exclaimed. "Damon," I said to myself, "what in the world are you doing?"

My radio beeped, and I expressed thanks to the Universe as I answered it.

It was Damon, of course. "Hello, Ilona," he said. He sounded somber.

"Hello, yourself," I said, trying to sound lighthearted. "What are you doing, Damon?"

His words were strained, as if he was choosing them very carefully. "What am *I* doing? Ilona, I'm not sure what it is *you're* doing. According to my monitor, you've already passed the escape horizon."

"Yes, but—"

He wouldn't let me continue. "I never expected you would pull a stunt like this. I didn't realize you were that anxious to win. I'm not going to let you. If you're willing to sacrifice your life for a posthumous victory—well, so am I. Adlus out."

"No!" I shouted, but it was too late. I wanted to scream at Damon, tell him to turn around, to run away, to flee. But I

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couldn't. My radio would only connect with Base One, not with Damon's ship.

And on my viewscreen, I saw him approach the imaginary radius of his ship's escape horizon, the same barrier I had crossed only a short time ago. The only difference was that I knew I could get out. He couldn't. The tidal forces which my Imalium hull could withstand would rip Damon's ship apart like tinfoil.

Against my nature, I cursed loudly. Base One beeped me, and as soon as my mind registered that they were signaling me, I cut off the radio. I had to think fast if I was going to keep Damon from killing himself for nothing, and I didn't have time for distractions.

Luck was with me in at least one respect. I tracked Damon's ship, and discovered that its motion was steady. Damon might be aiming towards the center of the black hole, but he wasn't eager to dive in. In fact, his ship's thrusters were fighting the gravity every centimeter of the way.

I adjusted my own ship's orientation and engines so I could follow, and I set the thrusters to let me drift only slightly faster than Damon's ship. I needed to get close to him, but I didn't want to overtake him, because—

The escape horizon! I had been so unconcerned about passing the escape horizon for a ship with a Tourtellium hull, that I had briefly forgotten about the possibility of actually needing to know the escape horizon distance for an Imalium hull. Fortunately, I had already calculated it before the dive, just in case, as it would have been suicidal not to. I quickly programmed the computer to signal me if we drifted too close to an Imalium hull escape horizon.

Fortunately, the lights stayed green. As I approached Damon's ship, I considered carefully the logistics of this rescue. There was really only one chance. If I could grab his ship before he crossed the radius of my ship's escape horizon, I would be able to rescue him.

I had to be careful. As always, my engine had to fire continuously, in order to keep my ship from falling any farther into the black hole. But now, at the same time, I had to maneuver the grapple to grab Damon's ship, so I had to take into account our relative motion as well.

And if Damon saw what I was doing and decided to burn more thrust before I had a chance to grab him . . .

I don't think I have ever sweated as much as I did during those few seconds. I uttered a short prayer as I watched the grapple get closer and closer. Just as the grapple got to Damon's ship, I saw his thrusters sputter and shut down. He was out of fuel, which meant I had to act immediately. I pushed a button and closed the jaws onto Damon's ship.

One second passed, then another and another. The grapple held, and I let myself breathe again. Now that I had Damon's ship, my thrust wasn't enough to keep us from drifting inwards, and I instructed the computer to fire the engines at maximum thrust.

We continued to drift towards the center of the black hole.

I started hyperventilating, then did my best to calm down with slow, easy breaths. Because of my agitation it took me a moment, which I could barely afford, in order to understand the problem. Grabbing onto Damon's ship meant that my ship had to move twice as much mass away from the black hole, and even my maximum thrust wouldn't work on so much mass. There was no way I could generate enough thrust to get both of the ships away from the black hole, especially since Damon's ship was out of fuel. What was I going to do now?

Then it hit me. I needed to rescue Damon, but I didn't need to rescue his ship.

Using the grapple, I positioned our ships so the airlocks would connect and, fortunately, God was with me. The ships slid together easily, with a loud boom and a click that indicated we were con-

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nected. I jumped out of my seat, ran to the airlock, and pushed the button to open it.

"Come on," I said, and shuffled my feet back and forth while the gears whirred. What if Damon, seeing what I was doing, had decided to wait until our ships were locked together, and then burn more thrust? I had to get through, to stop him, to rescue him . . .

As soon as the airlock door grew large enough to accommodate my body, I slid through. "Damon!" I shouted as I ran into his ship. "It was a trick! I'm not—"

I stopped shouting when I saw Damon, sitting unconscious in the pilot's seat. I grabbed his shoulders and put my ear to his mouth.

Faint breathing. I guessed that he had taken a sleeping pill so he wouldn't have to meet death head-on.

This made the rescue a little harder, but fortunately not impossible. I went to his control panel and turned the dial that lowered the artificial gravity on the ship. Normally we dove at one *g*, but for carrying Damon back to my ship, I figured that point-one *g* would be best. I wanted his weight lighter, but I also needed to be able to keep my feet on the floor.

Fortunately, Damon was small, and massed only about sixty kilograms. By lowering the gravity to a tenth of normal Earth gravity, I managed to reduce his weight to a shade under sixty newtons.

I lifted Damon out of his pilot's seat, and carried him over to the open airlock. I hesitated momentarily before stepping through; crossing the gradient felt odd.

Back on the ship, I carefully placed Damon on the mat which served as a bed. I returned to my seat, pushed the button which closed the airlock, and then flipped the switch to open the grapple, detach the connection, and release Damon's ship.

It didn't work. I felt cold and queasy, and flipped the switch again.

This time, the grapple opened. Sighing heavily, I retracted the grapple, and uttered a short prayer. My engines were already burning at maximum thrust, but would that be enough?

I studied the viewscreen. Sure enough, my ship had started to move slowly away from the black hole, and I breathed a sigh of relief. As we drifted towards safety, on the viewscreen I watched Damon's ship accelerate quickly downward and inward, a required sacrifice to the black hole in exchange for our lives.

I blacked out.

When I came to, I found myself lying on a bed in an infirmary room on Base One. Damon was standing over me, a grim look on his face.

"How are you feeling?" he asked.

I sat up, and my head felt dizzy. "Fine, I think."

He nodded. "Good." He looked around the room, then back at me. "That was a neat trick, Ilona."

"Trick?"

"The technical crew is studying your ship right now. Why didn't you tell me about the new hull?"

Damn. "Damon, I tried—" I started to say, but Bleen walked in. He looked as smug as any Pookrah could. Ignoring Damon, he came right to my side and said, "Perfect."

I shook my head to clear out the dizziness. "Perfect?"

"Yes, perfect. Your rescue of Adlus was broadcast everywhere. The entire galaxy is wondering how you managed to survive. The publicity for the Imalium hull is better than we had anticipated."

Now I remembered the one thing I didn't like about the Pookrah. Sometimes they seemed a little *too* human. Bleen hadn't even bothered to ask me how I was feeling.

"Publicity?" I asked. "Bleen, are you crazy? We can't go with this." I looked at Damon; from his facial expression, it was clear that he was starting to put it

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all together. I turned back to Bleen. "My stunt almost got Damon killed!"

Still ignoring Damon, Bleen looked down and up. "You are being naïve," he finally said. "There have been casualties before. But that was not the case today. And yes, I said 'publicity.' With your rescue of Adlus along with your dive record, the publicity will be ten times as valuable. My company will be able to sell that many more Imalium hulls, and your percentage will yield even more rewards for you."

I shook my head. "The money isn't worth it. Don't you understand? I almost got Damon killed out there!" I took a deep breath. "I'm breaking my contract."

Bleen removed a palm computer from his pocket and typed in a few numbers. "Carrus, this is the amount of money you are giving up," he said, and held the computer out to me so I could see the figure.

I repressed an urge to whistle.

"Carrus," he continued, "if you do not fulfill your contract, your complicity will become known anyway. The only difference is that you will not benefit from your actions."

I stood up; the dizziness had passed. I looked Bleen straight in the eyes, and spoke slowly and clearly.

"I don't care," I said.

"That is surprising," Bleen replied, "given your eagerness when I first made the offer."

That stung, partly because Damon was still there and listening with interest, but mostly because Bleen was right. "You know," I said to neither Bleen nor Damon in particular, "when I started this, it was all a lark. Well, not really. Piloting spaceships was OK, but I wanted to do something significant, something that I could point to with pride. So I tried diving, and surprised everyone by making such a big splash in my first competition. And then I kept winning.

"But you know what? I let the success go to my head. Not every dive can be a winner, or will be, but I had won my first few so easily that I never had a chance to absorb that lesson. I became too obsessed with being the best. And that's not what it's all about."

"Then what is it all about?" Damon asked softly.

"It's about always striving to do better than I did before, and not to worry about how I compare to others." I turned to Bleen. "Bleen, I wasn't in my right mind when I agreed to this stunt of yours. I wanted fame then—but I don't want this sort of fame. Take your contract, take your money, and get out."

Bleen sniffed in the way Pookrah do when they're upset, but he had nothing more to say. He pocketed his computer and left the room.

Which still left Damon. He was staring at me curiously, and I felt acute embarrassment. "Do you really feel that way, Ilona?"

I thought for a moment. "Yes," I said. "I do now."

"I'm glad. Because—well, you lost the championship."

"What?" For a moment I felt jealousy, but then I let it fade. "That's not possible. I had the Imalium hull."

"Yes, but—Ilona, what are the rules for winning the contest?"

Damon's question confused me. "You have to pilot your ship closer to the black hole than your opponent does."

"Yes," Damon said, with a sad smile on his face. "And whose ship got closer? Thanks to you—"

I got it. "*Oy.* Thanks to me, your ship was closest."

He nodded. "When you rescued me, the simple fact that I had piloted my ship closer to the black hole never occurred to you." He grinned wryly. "It's a good thing the rules require the pilot to be on the ship when the record is taken, or else the entire season would be one suicide run after another. Pilots would bail out of their ships at the last second. . . ." He shook his head.

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"So I didn't win."

"Don't worry about it. I didn't win either."

That made no sense. "What are you talking about?"

"Thanks to your stunt, they invalidated the contest. We're supposed to compete again, in a week's time—using identical hulls."

I laughed. "But the rules don't say anything about the hulls having to be the same."

"They do now. Oh, personally, I agree with you—by all rights, the contest should be declared over."

"That's because you'd be declared the winner," I interjected.

He smiled and shrugged. "Even so, I think it's just the hyperwave networks smelling more money. After all, think of the audience they'd pull in if we had to dive again."

"I can imagine."

He nodded. "So are you ready? They want to interview us."

I took a breath and nodded. "Ready."

We headed for the door, and then Damon took me by the shoulder and stopped us for a moment. "Ilona, I just wanted to say—even without the special hull, you're the best."

I flashed him a quick smile, and replied, "So are you." Then the two of us went to meet our public together. ■

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M. Todd Washington, Ph.D.

PROTEINS and PROTEIN ENGINEERING

The Wet Side of Nanotechnology

"New" technologies often occurred first in some form in nature. So why not copy from the best?

A nanometer—one billionth of a meter—is the length of four copper atoms lined side by side. The ability to build materials and machines at this scale is nanotechnology. Imagine nanometer-sized machines with moving parts capable of performing work. Are these the stuff of science fiction? Are they the stuff of a future technology? Well, not exactly.

A few years ago, I attended a seminar by Professor Richard Smalley, recipient of the 1996 Nobel Prize in Chemistry for the discovery of fullerenes. In his talk, he described two sides of nanotechnology: a dry side and a wet side. The dry side, the subject of Dr. Smalley's seminar, is a future technology. It envisions materials and machines built from nonbiological components, such as fullerenes (buckyballs and carbon nanotubes) and silicates.[1]

By contrast, the wet side of nanotechnology is not just a future technology. It's already here and has been for billions of years. It's the very foundation of life. Living things exercise exquisite control over their molecular structures, and they use nanomachines to carry out most biological processes. In this article, we will explore the wet side of nanotechnology.[2] First, we will look at several examples of proteins, nature's nanomachines. We will examine their atomic-level structures and see how they function. Then, we will discuss the emerging field of protein engineering—the use of genetic engineering to design and build new nanomachines with medical, industrial, and environmental applications.

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[1] Dr. Stephen L. Gillett's "Near-Term Nanotechnology" (*Analog*, October 1998) is an excellent discussion of the dry side.

[2] Biological nanomachines work in the "wet" interior of living cells. Thus they are the "wet" side of nanotechnology.

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Part One: Molecular Switches, Motors, and Pumps

Proteins are biological molecules which carry out a wide range of tasks. Some proteins play structural roles; they serve as scaffolds for assembling other molecules, they give shape and support to cells, and they hold neighboring cells together. Others proteins, called enzymes, serve as catalysts to accelerate the rate of various chemical reactions by staggering amounts, typically a billion to a trillion-fold.

However, some proteins do more than provide structural support and catalyze reactions; they use chemical energy to fuel various mechanical activities. These proteins are molecular machines. Here we will consider in detail three such machines: a switch, a motor, and a pump. I have chosen these examples because they illustrate nicely the general principles underlying the structure and function of all biological nanomachines. As we go through these examples, keep in mind that we may use them as models for building our own nanomachines. Thus the study of these proteins helps us not only to understand the molecular basis of life, but to envision—and perhaps someday create—nanomachines of our own.

Protein Structure. Before considering specific proteins, we should discuss a few general features of protein structure. Proteins are large by molecular standards, often measuring several nanometers across. They are made of amino acid building blocks (about 50 to 2,000 amino acids) linked by covalent bonds to form linear chains. There are twenty different kinds of amino acids found in proteins, each with a different size (10 to 30 atoms), shape, charge, and chemistry, and these amino acids can be linked in any combination.

In addition to the linear sequence of the amino acids, proteins have complex three-dimensional structures. Weaker noncovalent forces (hydrogen bonds, ionic interactions, nonpolar interactions) between the amino acids cause the linear chains to fold into compact, globular structures. Because amino acids can be linked in any combination, proteins possess tremendous variability in three-dimensional structure.

The three-dimensional shape of a folded protein determines the protein's function. Many folded proteins have small pockets, called active sites, which they use to bind other molecules. The pocket's size, shape, and arrangement of chemical groups allow only a specific target molecule to fit into the active site as a key fits into a lock. Also, many folded proteins have flexible regions, which can act like nanometer-sized latches, catches, levers, hinges, pistons, springs, and drive shafts. *Often a flexible "motif" is linked to an active site so that the binding and reacting of a molecule within the active site changes the protein's conformation (overall three-dimensional shape).* This, as we shall see, is the basic principle underlying the function of all biological machines.

Ras: A Molecular Switch. Switch proteins are molecular machines that exist in two conformational states: an "on" state and an "off" state. As switches cycle between the "on" and "off" states, they regulate a variety of biological processes. Among these are cell growth and division, DNA replication and repair, gene expression, learning and memory, and sensory perception.

The switch protein Ras is part of a signaling cascade regulating cell growth and division. A signaling cascade is a series of switch proteins, which relays information or instructions from one part of a cell to another or from the exterior of the cell to the interior. Essentially, the job of Ras is to relay a growth signal from an upstream switch to a downstream switch, so that the downstream switch can in turn send the growth signal on toward the cell's nucleus.

Ras, a relatively small protein, has

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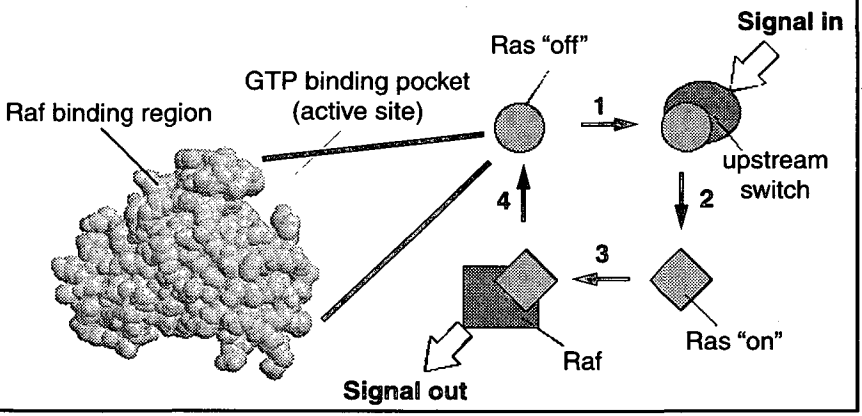
Figure 1 The Ras switch



about 200 amino acids. The atomic-level structure of Ras was determined by X-ray crystal diffraction techniques (Milburn *et al.*, 1990), and this structure is shown in Figure 1. Each sphere represents an individual atom (hydrogen atoms are not shown). Ras has an active site, which binds to a small molecule called GTP (*guanosine triphosphate*) and catalyzes the removal of a phosphate from the GTP to form GDP (guanosine *diphosphate*). This chemical reaction modulates the conformational state of Ras. When GTP is in the active site, Ras is in the "on" state, and it relays the signal to grow and divide. When GDP is in the active site, Ras is in the "off" state, and it does not relay the growth signal.

Ras controls cell growth by cycling between the "on" and "off" states (Figure 1). The "on" state is depicted as a diamond, while the "off" state is depicted as a circle. Starting in the upper left of the figure, Ras is normally bound to GDP and is turned off. In the "off" state, Ras is waiting to interact with the upstream switch of the signaling cascade. *Step 1*: In response to an extracellular growth signal, the upstream switch protein transiently binds to Ras. *Step 2*: Upon interacting with the upstream switch, Ras releases its GDP and subsequently binds to GTP. This induces a conformational change turning Ras on. *Step 3*: In the "on" state, Ras is able to bind to another protein called Raf. Raf is the downstream switch of the signaling cascade, and it becomes active upon binding to Ras. *Step 4*: Finally, Ras cleaves a phosphate from the GTP to form GDP. This induces another conformational change turning Ras off again.

By comparing the positions of the atoms between the "on" and "off" structures, researchers have determined the precise nature of the conformational changes that turn the switch on or off (Milburn *et al.*, 1990). When the extra phosphate of the GTP is present in the active site, the atoms around it rearrange to accommodate the extra size and negative charge. As these atoms rearrange, neighboring atoms have to rearrange as well creating a "domino effect." Linked to the active site of Ras is a flexible region that acts like a "latch." The "latch" moves to interact with a "catch" near the Raf binding region, and this interaction make Ras competent for binding Raf. When Ras cleaves the extra phosphate of the GTP to form GDP, the

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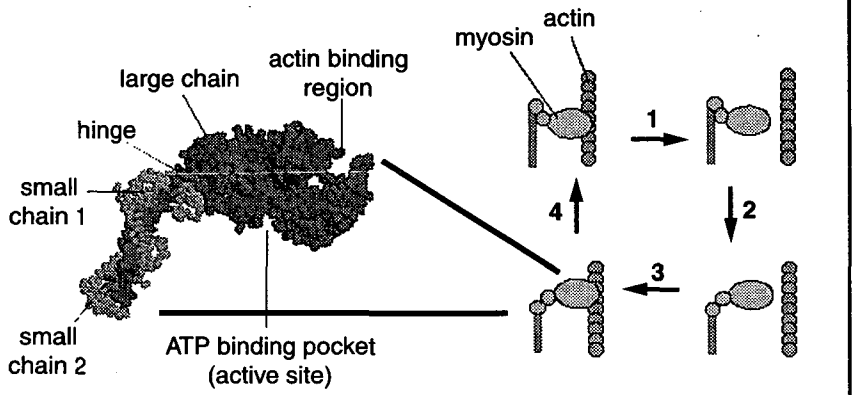
Figure 2 The myosin motor



"latch" and "catch" separate, the atoms return to their original positions, and the Raf binding region is disrupted.

In Ras, these conformational changes are structurally localized to a small region of the protein, only about a half a nanometer across. In the following examples, we will see that conformational changes can be much larger, changing dramatically the overall shape of proteins. Such conformational changes can exert mechanical forces or transport materials.

Myosin: A Molecular Motor. Motor proteins are molecular machines that serve a specialized function; they convert chemical energy into mechanical work. Cells use motor proteins to move around, to deliver materials to various sub-cellular compartments, to replicate and repair their genetic material, and to carry out cell division. Here we examine the motor protein myosin, which provides the force during muscle contraction.

At the molecular level, muscle tissue is made up of two types of protein filaments: thin and thick filaments. The thin filaments (10 nanometers wide) are made of a structural protein called actin. The thick filaments (25 nanometers wide) are made of the motor protein myosin. Muscle contraction results when myosin applies a force to the actin causing the thin and thick filaments to slide over one another decreasing the overall length of the muscle fibers.

Myosin, a rather large protein, is made up of six separate amino acid chains that come together to form a single protein with about 5,000 total amino acids. The structure of a portion of the myosin protein was determined at the atomic level by X-ray crystal diffraction techniques (Rayment *et al.*, 1993). As shown in Figure 2, myosin has a head and tail. The head is about 5 nanometers wide, and it extends from the tail at an angle. On the head is a binding site for the actin filament and an active site that binds a small, but important molecule called ATP (*a*denosine *tri*phosphate).[3] As myosin catalyzes the cleavage of a phosphate from ATP to form ADP (*a*denosine *di*phosphate), myosin undergoes a conformational change. This conformational change is not fully understood in

[3] ATP, which is closely related to GTP, is the most common biological fuel, and whenever it is cleaved, its chemical energy can be used to do work.

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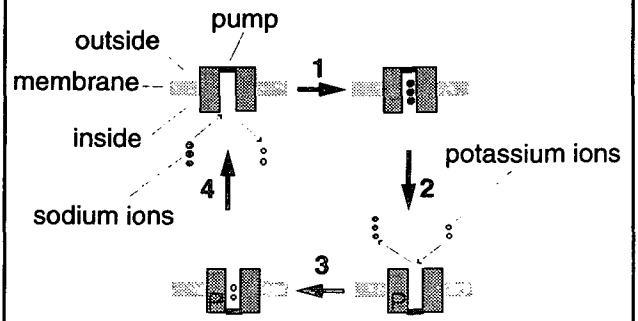
Figure 3
The sodium-potassium pump



atomic detail, but it is thought to involve a "hinge" where the tail and head come together. This makes the entire myosin molecule act like a lever that applies a mechanical force to the actin filament.

Figure 2 shows how ATP cleavage drives conformational changes in myosin that leads to movement of the actin filament and to muscle contraction. Starting in the upper left of the figure, when the active site of myosin is empty (without ATP or ADP), myosin is bound to the actin filament with the tail swung forward. *Step 1*: On ATP binding, the myosin head changes so that it no longer binds to the actin. *Step 2*: Once the myosin separates from the actin, it cleaves the ATP to ADP and phosphate. This drives a conformational change in the hinge, and the tail swings backward pushing the head forward. *Step 3*: Next, myosin now rebinds to the actin filament some distance ahead of the previous binding site, because the head moved forward. *Step 4*: Once the myosin binds to the actin filament, it releases the ADP and phosphate. This induces another conformational change in the hinge, and the tail swings forward pulling the head backward again. This final conformational change, called the power stroke, applies a small force to the actin filament.

Due to innovations in experimental techniques during the last five years, the size and strength of the power stroke of myosin have been measured (Simmon, 1996). Myosin's power stroke moves the actin filament about 10 nanometers, and it generates a force of 2 to 6 piconewtons (trillionths of a newton—the force required to accelerate a one-kilogram mass one meter per second squared).

The Sodium-Potassium Pump: A Molecular Pump. Pump proteins are molecular machines that transport materials, such as ions, across cell membranes against concentration gradients.[4] Concentration gradients are critical to the function of most cells. Nerve cells, for example, require higher levels of sodium ions outside the cell and higher levels of potassium ions inside the cell. When an impulse travels along the length of a nerve cell, sodium ions flow into the cell and potassium ions flow out of the cell disrupting the sodium and potassium gradients. For the nerve cell to fire again, these gradients must be restored; the sodium must be pumped back out of the cell and the potassium must be pumped back into

[4] A concentration gradient exists when a membrane, which ions cannot normally cross without help, has a higher concentration of ions on one side of it than the other side. Since systems tend to maximize entropy (the Second Law of Thermodynamics), ions will tend to flow from the side of higher concentration to the side of lower concentration. Thus transporting ions in the opposite direction requires the input of energy, typically ATP cleavage.

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the cell. The sodium-potassium pump does this using two-thirds of the total ATP produced by the cell.

Unfortunately, we do not yet know the atomic-level structure of the sodium-potassium pump. It is known that this pump has two large chains, each with about 1,000 amino acids, and two small chains, each with about 500 amino acids. The protein sits in the exterior membrane of the cell, and each large chain crosses through the membrane eight times. There are binding sites for sodium and potassium ions, which can face either the interior or exterior of the cell, depending on the protein's conformational state. On the interior side of the cell, there is an active site for catalyzing ATP cleavage.

As the pump cleaves one molecule of ATP, it pumps three sodium ions out of the cell and two potassium ions into the cell. Like Ras and myosin, the sodium-potassium pump works by cycling through several conformational states (Figure 3). Starting in the upper left of the figure, the binding sites for three sodium ions face the inside of the cell. *Step 1*: In this state, three sodium ions bind to the inner face of the sodium-potassium pump. *Step 2*: Next ATP binds within the active site and is immediately cleaved to ADP and phosphate. The ADP releases, but the phosphate group attaches through a covalent bond to a specific amino acid of the pump protein. The atoms rearrange to accommodate the addition of the phosphate group, and the protein undergoes a large conformational change. Now the sodium atoms find themselves facing the outside of the cell with their binding sites disrupted. Now the pump protein releases the sodium atoms to the outside of the cell. *Step 3*: In this state, binding sites for two potassium ions face the outside of the cell, and two potassium ions bind to the outer face of the pump. *Step 4*: Finally, the protein catalyzes the removal of the phosphate group. This causes the protein to switch back to the original conformation, with the potassium ions now facing the inside of the cell with their binding site disrupted. The pump releases the potassium ions inside the cell, and the cycle continues as three sodium ions bind to the inner face of the pump.

Part Two: Engineering Proteins with Novel Functions

We have just seen how some of nature's nanomachines function; they cycle through a series of conformational states that allow them to perform specialized tasks. Imagine designing and building new nanomachines that function in a similar manner. These nanomachines must be as structurally intricate as proteins, and they must possess moving parts where hundreds of atoms can rearrange upon binding other molecules.

Although designing and building new nanomachines sounds impossible, the outlook is actually quite good. One caveat, however, is that these machines may have to be engineered proteins. This way, we can use bacteria (or some other organism) to construct them for us. All we have to do is focus on designing them—still not an easy task. Before discussing some recent advances in designing novel proteins, we will first examine briefly the technology that makes this all possible.

Genetic Engineering. Exactly what are genes? Simply put, genes are the blueprints for making proteins. A gene is a region of a DNA chain, and its sequence of bases (its G, A, T, and C building blocks) encodes the protein's amino acid sequence.

The last two decades have witnessed the explosion of genetic engineering. Molecular biologists have developed techniques to manipulate DNA sequences virtually at will. They can take genes from one organism (such as a human) and introduce them into another (such as a bacterium). They can cut and

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paste genes or parts of genes, and they can even rewrite the base sequence itself.

By changing the base sequence of a gene, protein engineers can readily change the amino acid sequence of the encoded protein. Amino acids can be substituted by other amino acids with different properties. Entire regions of proteins can be modified, swapped with regions from other proteins, or even eliminated outright. In fact, new genes encoding new proteins can be synthesized from scratch.

Using this powerful technology, we can make almost any amino acid sequence we desire. The real problem is designing proteins that will actually fold properly and do something. So far, protein engineers have come up with three approaches to creating proteins with novel functions: modifying existing proteins, designing new proteins, and using selection to "evolve" new proteins.

Modifying Existing Proteins. This approach holds the most promise in the short term. It does not require a detailed—and as of yet, unrealized—understanding of protein structure. Instead researchers start with proteins existing in nature, and they make changes to these proteins to see if they can alter their functions. This approach is encouraging because as more atomic-level structures of proteins are being determined, we are finding that proteins have a modular organization. The ATP binding pockets of many different proteins are similar to one another. The flexible regions, like the "latch" and "catch" motifs of Ras and the "hinge" motif of myosin, may be found in many other protein machines as well. Protein engineers may be able to use these modules as building blocks to assemble new proteins.

One current example of this approach is the creation of immunotoxins, engineered proteins with the potential for fighting cancer. An immunotoxin is a hybrid of modules from two proteins: a toxin and an antibody. Toxin proteins, produced and released by infectious bacteria, bind to the surface of a host cell, penetrate it, and kill it. Toxins are so potent that just a few molecules are sufficient to kill a cell. Antibodies, on the other hand, are proteins produced by the immune system that recognize and bind to specific foreign materials. By fusing a part of the gene encoding a toxin with a part of the gene encoding an antibody recognizing surface features of cancer cells, researchers have created a new gene. This new gene encodes a protein that binds only to cancer cells (via a module from the antibody protein), penetrates them and kills them (via modules from the toxin protein). In studies using mice, these engineered proteins successfully eliminated certain tumors, and trials with human subjects are beginning.

Protein engineers are creating other modified proteins that may soon have medical and industrial applications. However, the vast majority of the work on existing proteins has a more basic goal—discovering protein design principles that can be used to construct new proteins more or less from scratch. After changing certain amino acids, researchers examine the structural and functional consequences of these alterations. Doing this, they have amassed a great deal of data that have been useful to protein engineers working on the design of new proteins.

Designing New Proteins. This approach requires the most knowledge about protein structure. Protein engineers are trying several strategies to design new proteins. One somewhat successful approach involves the building of simplified proteins. These proteins are small (less than 100 amino acids) and have very regular, static structures. The most common simple structure is the four-helix bundle, which has been surprisingly easy to design. The single

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amino acid chain of this structure forms four short antiparallel (up-down-up-down) helices that wrap around one another.

Most natural proteins, however, have more complicated folds. Recent approaches to designing these complicated structures involve computer-assisted strategies. For years, scientists have observed the tendency of each amino acid to be in a given structural element. Certain amino acids are more common in rigid portions of a protein, while other amino acids are more common in flexible loops. Certain amino acids are more common in the core of proteins, away from water, while others are more common on the surface exposed to water. Based on such observations, researchers have written programs to use immensely complicated principles to help design proteins.

One example is the program described by Dahiyat and Mayo (1997). Using coordinates, one inputs the positions of many of the atoms in a desired folded structure. The computer then begins searching through the possible amino acid sequences for one that—assuming the algorithm is correct—will fold into this target structure. After days of computations, a semi-exhaustive search is completed, and the computer outputs the best amino acid sequence. An initial test of this program was successful. The input was a complex three-dimensional structure of a small protein (only 27 amino acids). When the output sequence was made, it folded into the specified structure.

This study and others like it are major accomplishments, but protein engineers are still a long way from where they want to be. Using these strategies, they can design a few, small protein structures, less than 100 amino acids long. In addition, they are only capable of designing static structures, not ones with conformational flexibility. Nevertheless, this approach is promising and worth watching.

Selecting New Proteins. This last approach to making new proteins is entirely different. New proteins, possessing desired properties, are selected from a large, diverse population of proteins. Variation followed by selection: this mimics nature's approach to designing proteins, evolution. By employing clever selection schemes, researchers are able to direct the evolution of new proteins in the laboratory.

The most common method to select for new proteins is called biopanning, which can be thought of as "molecule fishing." This technique allows us to select for proteins that can bind a specific target molecule. Let's look at an example to see how this works. We start by attaching the target molecule (the "bait") to the surface of a dish. Then we take a solution containing an enormous pool of different, often random, amino acid sequences, and we pour this solution into the dish. Only the amino acid sequences in the pool that bind the target ("bait") will be attached to the dish and thus be "caught." Once the other proteins are washed away, we have only a couple of sequences, out of the original trillion or so, bound to the dish. These are the proteins with the desired properties.

Of course, it is not this simple. To do anything further with the proteins attached to the plate, we need to identify them—to know their amino acid sequences. Unfortunately, we need a vast number of copies of a sequence in order to do this, but only one copy of each sequence can be recovered from the surface of a dish. An ingenious technique called *virus display* gives us the ability to make many additional copies from a single protein selected in this manner.

The technique of virus display, as its name implies, involves fusing the random amino acid sequences directly to a virus's surface proteins. Instead of starting out with a pool of amino acid sequences, we start out with a pool of viruses displaying different amino acid

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sequences on their surfaces. Let's look at this selection scheme again. The pool of viruses displaying the random amino acid sequences is applied to the plate. The viruses that do not bind the target are washed away, and only the few viruses that bind the target "bait" via their displayed sequences remain. These "caught" viruses are then stripped from the plate and used to infect bacteria. Inside the bacteria, these viruses make many copies of themselves and the selected amino acid sequences, now allowing these amino acid sequences to be identified.

Concluding Remarks. Although the creation of new proteins by rational design and selection is still in its infancy, progress on these fronts has been rapid. We are still decades from designing working proteins using either of these two approaches. However, when this goal is achieved, the only limiting factor will be our imaginations.

I began this article mentioning the 1996 Nobel Prize in Chemistry for the discovery of fullerenes, and I am going to finish by mentioning the 1997 Nobel Prize in Chemistry. It was awarded to Paul Boyer and John Walker for their work on the ATP synthase protein[5] and to Jens Skou for discovering the sodium-potassium pump. As the 1996 Nobel Prize was an acknowledgment of the dry side of nanotechnology, the 1997 Nobel Prize was an acknowledgment of its wet side. ■

[5] The ATP synthase, a rotating motor, is in my opinion the most remarkable protein machine. It is the primary source of ATP in all living cells, and it makes ATP using the energy stored in an ion concentration gradient.

Acknowledgements

I thank the faculty, staff, and students of the Department of Biochemistry at the Ohio State University for opening my eyes to the amazing world of protein structure and function. In particular, I thank Christine M. Kondratick, Manju M. Hingorani, and Kristen M. Picha for commenting on several drafts of this article.

About the Author

Todd Washington is a native of Ohio and life-long fan of hard science fiction. In 1998, he received his Ph.D. in biochemistry from the Ohio State University, where he studied the structure and function of motor proteins involved in DNA replication. He currently is a post-doctoral researcher at the University of Texas Medical Branch at Galveston, where he is studying the processes of DNA repair. Other than several research papers, this article is his first publication.

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Bibliography

1. Alberts, B. *et al.* (1994) *Molecular Biology of the Cell*, 3rd Edition. Garland Publishing, Inc. New York.
2. Block, S. M. (1996) "Fifty ways to love your lever: myosin motors." *Cell* 87, 151–157.
3. Dahiyat, B. I. and Mayo, S. L. (1997) "De novo protein design: fully automated sequence selection." *Science* 278, 82–87.
4. DeGrado, W. F. (1997) "Proteins from scratch." *Science* 278, 80–81.
5. Gillett, S. L. "Near-term Nanotechnology." *Analog*, October 1998.
6. Hill, H. R. and Stockley, P. G. (1996) "Phage presentation." *Molecular Microbiology* 20, 685–692.
7. Howard, J. (1997) "Molecular motors: structural adaptations to cellular function." *Nature* 389, 561–567.
8. Milburn, M. V. *et al.* (1990) "Molecular switch for signal transduction: structural difference between active and inactive forms of protooncogenic *ras* proteins." *Science* 247, 939–945.
9. Osuna, J. *et al.* (1994) "Microbial systems and directed evolution of protein activities." *Critical Reviews in Microbiology* 20, 107–116.
10. Pastan, I. (1997) "Targeted therapy of cancer with recombinant immunotoxins." *Biochimica et Biophysica Acta* 1333, C1–6.
11. Plaxo, K. W. *et al.* (1998) "Simplified proteins: minimalist solutions to the protein folding problem." *Current Opninion in Structural Biology* 8, 80–85.
12. Rayment, I. *et al.* (1993) "Three-dimensional structure of myosin subfragment-1: a molecular motor." *Science* 261, 50–57.
13. Regan, L. (1998) "Proteins to order?" *Structure* 6, 1–4.
14. Sellers, J. R., and Goodson, H.V. (1995) "Motor proteins 2: myosin." *Protein Profiles* 2, 1323–1339.
15. Simmons, R. (1996) "Single-molecules mechanics." *Current Biology* 6, 392–394.
16. Smalley, R. E. (1995) "Nanotechnology and the next 50 years" (lecture transcript) <http:/cnst.rice.edu/dallas12-96.html>.
17. Smalley, R. E. (1996) "From balls to tubes to ropes: new materials from carbon" (lecture transcript) <http:/cnst.rice.edu/aiche96.html>.
18. Taylor, E. W. (1993) "Molecular muscle." *Science* 261, 35–36.
19. Vale, R. D. (1996) "Switches, latches, and amplifiers: common themes of G proteins and molecular motors." *Journal of Cell Biology* 134, 291–302.
20. Voet, D. and Voet, J. G. (1995) *Biochemistry*, 2nd Edition. John Wiley and Sons, Inc, New York.

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Rajnar Vajra

ENHANCEMENT, INCORPORATED

Some future fashions may make life very difficult for, among others, detectives. . . .

The towering, frosted-glass inner doors of the Delton Corporation snickered shut behind me; there was no getting out of this now. I paused for a moment to take in the enormous room and its many busy occupants and to let their inevitable reaction to my latest disguise run its course. Maybe I also needed a few seconds to get my damn nerves under control; I'm an experienced troubleshooter but I'd never been involved in a *murder* investigation before.

The place smelled unnaturally fresh—a hint of mountain and a soupçon of forest. Massive air-cleaners prickly with negative-ion spikes were undoubtedly chugging away behind the scene. And on blue translucent stands scattered throughout the room, thick candles burned brightly enough to suggest that Delton was pumping in some extra oxygen. Productivity: hallowed be thy name . . .

My nose was claiming I was in the wilderness, but my other senses disagreed, detecting a large-scale, highly extravagant office built in the "open" style that had started right here in San Francisco a decade ago, back in 2020.

In the center was a sunken, octagonal area lined with soft-looking yellow-leather couches for casual business meetings. Around this cozy octagon was a vast floor of matte-finished curly maple supporting not only the blue stands but also the occasional copyfax machine, potted tree, miniature fountain, and stress relieving, glider-style rocking chair. Aside from the subtly warming candlelight, the place was illuminated by full-spectrum incandescent lamps mounted on the high, vaulted ceiling.

Most interesting, from my point of view, was that there wasn't a mirror in sight. Even to someone without my special gear, the lack of reflective surfaces would hint that most or all of the employees here were on the *View-Net*, subscribers to my company's services (or getting inferior enhancements from one of our competitors such as Larger Than Life or the upstart Imagine Yourself).

A sudden gasp erupted from the receptionist's desk—I'd finally been noticed. That gasp triggered a whole chorus (with a creaking accompaniment of swiveling chairs). The sound spread in a widening circle, getting louder near the

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walls because that's where most of the employees were sitting at their so-called "cubicles," curved and two-sided workstations. The gasps coming from the far end of the room lacked, I thought, the sincerity of the originals; but those workers were farther away and couldn't see me clearly. Perhaps only the receptionist, a young man whose enhanced face was his real one but with a better complexion, knew just how brightly my eyes glowed . . .

I strode over to his desk as confidently as I could with four hundred stares focussed on me and bent down to keep the conversation private.

"Can I help you, sir?" he asked, leaning away from me so far I was surprised he didn't fall over. Maybe I'd made myself a bit *too* intimidating this time.

"My name is Rig Gullintani."

"Oh. Oh yes. Of course! You're the fellow from Enhancement Incorporated, aren't you? That explains the . . ."

"I believe Ms. Benington is expecting me?" Lisa Benington was Delton's current CEO and also, oddly enough, a world-famous artist who worked in a unique medium.

"Yes, sir, she *is* expecting you. But you're a tad early and Detective Bell is running late. This is about what happened to poor Dr. Frankel isn't it? Sorry. I'm talking out of turn, aren't I? I'll just . . . let Ms. Benington know you're here. I hope you had a, a *pleasant* flight?"

As he mumbled into the intercom, he kept blinking and rubbing his eyes as if that would make a difference in the way I looked.

At last I took pity on the poor guy and turned to give the room another once-over. A small adjustment of my belt-module activated my pseudo-telescope. At least twenty people had sneaked little mirrors out of purses or pockets (tsk, tsk!) and were trying to get a glimpse of the real me. Not only was such behavior rude, in my case it was also pointless. The would-be spies would be wondering what the hell was wrong with their eyes. . . .

"Mr. Gullintani? I'm Lisa Benington," said a sugar-sweet voice and I quickly cancelled the telescope function. A slim, middle-aged-looking woman was moving towards me with the energetic stride of a teenager. She held her hand out—an unusual gesture these days, *highly* unusual in someone with an exorbitant, class four enhancement.

A bit star-struck, I smiled with my mouth closed and offered my own hand. If she was hoping to guess my true size this way, she too was in for a surprise.

"I'm honored to meet you Ms. Benington, I've admired your ion-sculptures for years. I'm just sorry we had to meet under these circumstances."

Outwardly, she was dealing with my unusual enhancement far better than the receptionist had but I sensed the strain. Our handshake couldn't have helped; my hand felt as big as it looked. Yet she continued bravely enough, "Thank you, sir. Will you please come with me? My office is behind the glass-brick privacy screen, the one against the west wall."

Ms. Benington, I decided, was a person with refined and seriously expensive tastes. Her desk lamp was a genuine Tiffany (or a damn good copy) and there were some wonderful Josh Simpson paperweights keeping it company. The nine-tier fountain in the corner seemed to be made entirely of blue topaz; it was larger than the ones in the main room and its "sonic perfume" was pleasant if a bit loud for intimate conversation.

The office, even by itself, implied money. It was spacious, impossibly spotless, and bright with a theater-size virtual window displaying a snow-capped mountain range. Clerestory windows added enough natural, afternoon sunlight so that I needed to make surreptitious adjustments to my module to keep the heads-up display visible. Meanwhile, I studied the contrast between how my host intended to look and how she really looked.

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The real Lisa Benington was at least fifteen years younger than her "mask" suggested and her true face had a clarity, dignity, and warmth closer to beauty than cuteness. Her need for an older, sterner appearance said nasty things about our society. It amazes me that women are *still* struggling for respect in the corporate world. Of course, I knew that this particular woman had been a reluctant draftee. . . .

"Would you care for coffee or tea, Mr. Gullintani?"

"Thank you, but no. Maybe later. Can you tell me when Detective Bell might be—"

A discreet chime had sounded.

"Perhaps he's already here," the CEO observed, sitting up straighter in her chair and activating her intercom.

Now I understood the fountain's purpose and why her intercom was parabolic in shape. From my chair, I couldn't hear a thing. But then, I only had the eyes of Heimdall, not his ears. . . .

"He'll be right in," she announced with a sharp new edge of tension in her voice.

Detective Winchester Bell walked around with his neck canted forward as if his head was determined to get places first.

He wore no enhancements, but that was to be expected; on-duty police officers are invariably prohibited from using our services. Even without View-Net modifications the man had a likable, intelligent face—partly Hispanic, partly black—with dark, ultra-smooth skin except for his chin which was covered with bumplets from ingrown beard-hairs.

Benington started to make introductions, but the detective waved his hand impatiently.

"Whoa," he grunted. "We all know who we are. But," he was looking me up and down, "I see the Enhancement people are buying the *economy* package now. Nice to see you in person, Mr. D—"

"Rig Gullintani." I'd interrupted before he could blurt out my real name.

His eyebrows went up, but he caught the ball and ran with it. "I gotta admit, Mr. Gullintani, you looked . . . smaller over the phone-link."

"Maybe I should hold up a tape measure whenever I'm in video conference with strangers?" How annoying. Why do people have to make such a damn fuss about *size?* Plus, I'd wanted to keep the View-Net clients here off-balance and Bell had just made it clear that my height, at least, was no high-tech illusion.

Lisa Benington had been watching the policeman intently, studying his reaction to me, but she had an issue of her own.

"Detective, do you still refuse to even *consider* the possibility that this horrible crime was committed by someone from outside my company?"

Bell sighed, shaking his head. "We've been over this a dozen times already, Ms. Benington. I've been working homicide for fourteen years now and I gotta tell you—these things fall into *patterns*. We're still investigating all avenues; my partner is out following some leads even as we speak. But when you really look at Dr. Frankel, look at who he was, you can't help but see—"

"But what about his social life? Or maybe he'd made an enemy *before* he came to work for us?"

"What social life? His *entire* life orbited around his work. And everybody *adored* the guy. I'm sorry, but experience says you've got a killer working here."

"I still think you should—"

"What I *should* do is talk to Mr. Gullintani in private for a minute. Where can we do that without interruptions?"

The CEO clenched her jaw but her enhanced face remained calm and relaxed, programmed not to display certain reactions.

"Detective Bell," she snapped. "After Michael—after my *husband* passed away—I was forced to take over his company because I was the only one

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who knew all of his plans. I didn't want to do it; at heart I'm an *artist,* not a businesswoman. But this is *my* company now and I'll do everything I can to protect it. And I'll tell you something: I don't like the way this investigation is being handled and I'm getting tired of your—your easy assumptions."

"I'll get right to work on that, Ms. Benington. Now, where can the big guy and me talk?"

"The best room, aside from this office, is Dr. Frankel's office. I assume you don't mind breaking through your own security tape? By now, I'm sure you know the way. If you need anything, use the intercom in there. When you have a chance, Mr. Gullintani, I'd also appreciate a word with you."

"Ever been to San Francisco before?" Bell was making small talk as he led me to the murder scene.

"Many times."

"What do think of it?"

"I never know how to judge an entire *city*, Detective; it's too big. I love the view from that restaurant on top of the Fairmont and I admire what they're doing lately in the Mission District. But just maybe Fisherman's Wharf has gotten a bit . . . touristy?"

The understatement made his lips twitch but he nodded seriously. "I get you. It's like I asked, 'Do you like kids?' They're all different. Hold up, we're almost there. Don't touch anything unless I say so."

I followed him behind a long privacy wall made of virtual-window panels displaying some tropical beach at sunset; hidden speakers provided a soothing accompaniment of crashing breakers. Then we stepped through a narrow archway into a softly-lit area with padded chairs and little tables with magazines. Obviously a waiting room. At the back was a door barred by strips of yellow tape reading, "POLICE BARRIER, DO NOT CROSS."

While Bell pulled the strips off, I looked around. The small desk in here had to be solid teak and its companion chair was a recent model Strand Secretary. Strand chairs change shape constantly and gradually, support you on a webwork of soft cables to allow air-circulation, and cost over three grand.

I wasn't envious about the chair, but on the desk was something I lusted after: a clear Plexiglas cube fitted with a black box on the top and another on the bottom. The cube contained perhaps a dozen individually colored ropes of glowing fog. The ropes twisted, changing shape and hue, twining around each other sensuously but never quite losing their identities.

A Lisa Benington ion-sculpture! I'd been disappointed not to find any in her own office and now I'd stumbled onto one, wasted in this abandoned space.

I'd read up on how they worked. In an *Architectural Digest* interview, Benington said she'd gotten the basic idea from an old exhibit at San Francisco's Exploratorium. But she was the one who refined the concept into high art.

The cube was filled with three noble gasses—argon, neon, and krypton—and the colors and shapes were generated by electric-discharge ionization mediated by tiny droplets of water moved around by tiny, precisely controlled air jets. Optical sensors told an onboard computer when the patterns were getting closer to or straying from Benington's programmed instructions and the computer made constant fine adjustments until the patterns matched.

All this took a lot of power and made enough electromagnetic fuss to put some "snow" into my heads-up display despite the mu-metal shielding on my belt-module. Three trivial error messages appeared in the display and I stepped back a pace, wondering about the long-term health consequences of so many *oersteds* dancing right next to you on your desk.

I wondered about something else too: you could buy *ten* Strand chairs for the

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price of this sculpture and Dr. Frankel had evidently given one to his secretary. . . .

"Mr. Gullintani? Let's step inside."

Bell was so eager to get us into Frankel's office that he grabbed me gently by the arm and tugged. Once in, he practically slammed the old-fashioned wooden door.

"You're probably wondering—" I began, but the detective held up a hand and shook his head. He reached into a pocket, fished out some electronic toy, activated it by pushing a button, and placed it on the floor in the center of the room.

"I'm not *saying* anyone bugged this place," he stated, "but now, if I *did* say it, no one but us would know. I can't *wait* to hear what question comes out of my mouth first."

"Why wait?" I was looking around the room nervously, but of course the body had long since been carted away. The walls were lined with bookcases stuffed tightly with books. Frankel's desk was teak just like his secretary's, but his chair was vastly inferior, a high-backed monstrosity covered with acres of black leather.

In general, it was a nice office. One thing I *didn't* like the looks of: a large, rusty-black stain on the ivory carpeting . . .

"Let's start with this one," Bell offered. "Why was everyone we passed on the way here staring at you like you had rainbows coming out of your butt?"

Odd coincidence, him using the word "rainbows."

"What on Earth do you mean?"

"Like they were seeing something wonderful and yet creepy."

"Well, if you were on the View-Net, Detective, you might look at me a little strangely yourself. To them, I'm a giant with—"

"But you *are* a giant!"

"Yeah, that makes the illusion especially convincing. But the giant *they're* seeing has eyes that glow, is dressed in thick furs that make me look *immense*, has a carved horn as long as your arm tucked in his belt, and a sword that's even longer."

"OK. So who are you supposed to *be?*"

"Heimdall." Bell looked at me blankly. "One of the old Norse gods. He was once known as 'Rig' which means 'creator.' Later, after Odin became popular, he got demoted to the guardian of Bifrost, the Rainbow Bridge leading into Asgard where the—"

"What's the point in looking like this Heimdall character?"

"My job, Detective, my *usual* job, is to investigate people suspected of cheating my company; the Universal-Credit system gives the . . . entrepreneur a lot of *leeway*. Sometimes I've got to deal with really clever hackers and I've learned that the more intimidating I look, the more likely it is that smart cheats will make stupid mistakes."

"I don't get it. Everyone knows it's a trick, right? For all I know, half the people out there are . . . dressed up as gods and goddesses."

"Few people are that *exuberant*, especially at work, although the Delton crowd seems more fanciful than most. But my disguise is special: considerably more . . . opaque and with better resolution than even a class *four* enhancement, and class four is the strongest commercially available level. Plus, if someone tries to see me in a mirror, they—"

"All right, I got the picture. Next question. When I finally reached you on the phone yesterday your name was Jackson Duke. What's with this 'Gullintani' crap? You don't even *look* Italian."

"Gullintani is another old Norse nickname for Heimdall. It means—"

"So who are you really?"

"I meant to warn you about this when we talked; my name *is* Jack Duke but I can't use it here."

"Why not?"

"Because someday I might need to return on a more . . . undercover investigation. And if someone out to bilk my

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company got hold of my true name, they could tap into the North American Data Base and keep track of my whereabouts. Kind of spoil the surprise when I showed up, disguise or no disguise. Particularly since the View-Net can't make a person look *smaller*."

"So? What are the chances you'll *need* to come here again? Enhancement Incorporated must have *hundreds* of troubleshooters."

"Actually—please keep this to yourself—but so far we've only found ten people capable of using the gear I'm carrying."

"Ah. The 'special gear.' You mentioned that on the phone. What kind of gear?"

"I've got a high-level link to the V-Net's main computer. It gives me several sensory options and generates little green letters and numbers in the upper left corner of my vision. I can see a client's "mask" or not as I choose and at the same time, get a readout of their entire enhancement history. That way I can study every design request they've made, every change they've programmed, since they signed up. You can learn a *lot* about someone that way. And what's more, I can use the computer as a pseudo-telescope, look at someone across the room and let the V-Net expand the image of their enhancement. Great for spying but it won't work on anyone who isn't a member."

"No problem *here*. Seems like everyone in that damn office belongs to your club. What are you seeing right now?"

"You've never signed up, so all I've got are three green zeros."

"Oh? Sure that's not a report on my recent sex-life? But I like your having a . . . secret window. Makes me feel like we're loaded for bear."

"The problem is, Detective, in this case the bear is probably loaded too."

I wanted to sit down, but it's hard to find a place to sit in an office where someone was stabbed to death. My eyes had adjusted to the room and I could see details I'd missed at first. Little specks of dried blood adorned the most unlikely places . . .

"Why should our bear be loaded?" Bell demanded.

"Do you know what the Delton Corporation *does*?"

"Sure. Other companies hire this one to design oddball machines and weird data systems. Right?"

"In principle, yes, but in *scale* no. This company is *important*. Major corporations come here with major problems—huge technical problems—or impossible ideas they want to implement. Delton produces solutions. Often that means pioneering new technologies. The people here are anything but stupid; the same kind of high-caliber brains created the View-Net. From what you told me on the phone, we may be up against someone smarter than you and me combined."

Bell was nodding his head. "Maybe. If so, we'll just have to catch 'em through sheer *persistence*, right?"

"Absolutely. Why don't you tell me more about the murder now? Unless you've got more questions?"

"They'll keep. But there isn't much I didn't cover on the phone." Bell pulled an old-fashioned paper notebook from his jacket and riffled through the pages. "Two days ago, on Wednesday, August seventh, at four o'clock in the afternoon, Dr. Frankel finished his last session of the day."

"Frankel was Delton's staff psychologist?"

"In-house therapist really. Free counseling sessions for troubled employees."

"Go on."

"At about two minutes after four, the doc and his last patient left this office together by the back way. Frankel then went to the john (an eyewitness saw him there) and five minutes later he showed up in his waiting room where he spent a few more minutes before coming back in here. His secretary, Mrs. Mattoon,

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who'd been on duty continually since three, swears that Frankel was the only person in here from four-eleven until she herself entered this room at four-thirty. That was her usual time to tell Frankel to knock off for the day; she tells me he was real absent-minded. She found him lying on the floor where you see that dark stain and she called the staff physician, Dr. Campbell, pronto. Campbell wasn't in *his* office at the time, but his nurse told Mattoon that the doctor was in the snack room. Mattoon ran to the snack room, and hauled Campbell's ass back here. Frankel was already dead. He'd been stabbed six times, three times in the chest from the front, once in the neck, and once in the back. The murder weapon was left on the scene: a Phillips-tip screwdriver with a six-inch shaft. No prints. You want the anatomical details?"

"God no!"

"As you can see, there are only two ways out of here. The patients would come in the waiting room door like we did and leave by that back door so they wouldn't encounter the next patient."

"And you'd said the back door opens only from *this* side?"

"Right. It leads to a small sitting room where the patient can get his act together before going back to work. Sometimes, I gather, these sessions got emotional. We're trying to keep the sitting room uncontaminated for now—there's still some fiber work to do—but it has another one-way exit that puts you behind the last section of the wall with the waves."

"Can these doors be propped open or jimmied?"

"Doesn't matter. When anyone is in the sitting room, indicator lights blink in both the office and the waiting room. It's a matter of privacy. Frankel wouldn't want to send a patient into the sitting room if someone were still in there. And if the doctor were using the john or something, Mrs. Mattoon needed to know when it was safe to go into the sitting room to straighten up.

"Maybe someone found a way around the lights?"

"Like hell! They're triggered by the same kind of optical scanners used in *bank vaults*."

"What about the lights themselves?"

"Nothing wrong there, they were working right before and right after the murder. And don't think Mattoon wouldn't notice 'em if they were on; they're *intense* and besides, that woman doesn't miss a thing. You haven't met her yet. Frankly, far as I can see you'd need to be *invisible* to sneak into this office without her spotting you or the lights giving you away."

"I'm starting to understand why you sent for me."

"Yes, sir. We've got a murder happening with no one in the room but the murdered man."

Clearly, Detective Bell thought that some View-Net miracle had been used to produce this real life locked-room mystery but no amount of enhancement can make a person invisible. Not yet anyway.

"What about footprints, Detective? With all these specks of blood on the carpet, you'd think the murderer would have left tracks."

"I'm sure he or she did, but after Mrs. Mattoon yelled for help, the word got out and three of Frankel's patients followed Dr. Campbell in here and muddied the trail real good. My working assumption is that this was a deliberate act and one of the three is the killer."

"Not necessarily. From all you've said so far there's a much simpler explanation: the secretary did it."

Instead of answering, Bell stepped behind Frankel's desk, used a pen to push the intercom button, and squatted down to align his head with the parabolic transducer. The voice on the other end was faint but there was no fountain here to make it inaudible.

"Angie Murphy speaking," a thin voice announced. "Is this Detective Bell?"

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"Right."

"Ms. Benington asked me to facilitate your requests. What can I do for you?"

"Just send Mrs. Mattoon down to Dr. Frankel's office, please. I assume she's working today?"

"Yes, sir. Right away, sir."

If my "mask" scared Clarice Mattoon, she didn't show it. She was a tall, rangy woman somewhere in her early sixties whose bright blue eyes glittered with alert curiosity mixed with obvious resentment. She glared at us as if we were profaning the room with our presence. Mattoon was another View-Net client and her class-three enhancement (remarkably expensive for a mere secretary) reminded me of my grandmother, Mary, who is somewhat portly and has a kind face and soft old-lady skin.

The effect wasn't glamorous but I could see how a therapist's secretary might want to look like someone's grandmother.

"I'm so sorry, Clarice," Bell said gently, "to make you come back in here. But I figured my associate—this is Rig Gullintani—might need to ask you some questions right from this spot."

Suddenly, Mattoon was a different woman; her real face softened, relaxing into deep lines of grief and loss.

"Thank you for explaining, Winchester. I thought you were just being . . . insensitive. Pleased to meet you Mr. Gullintani."

"The pleasure is all mine."

"At least you've brought along a polite one this time, Detective. How's your wife and daughter? And your partner?"

"Good," Bell replied. "They're all good. But how about you? How are you holding up?"

"I just try to get through each minute. . . ."

Bell turned toward me. "All right, mister. Here's the lady that was on the spot; see if *you* can figure out how this happened."

"Who was Dr. Frankel's last client of the day, Mrs. Mattoon?"

"That would have been the three-thirty, Eugene Cunningham. He's been a patient of ours since David—Dr. Frankel—and I came here ten years ago."

"You worked for Dr. Frankel before he was hired by Delton?"

"David and I have—had—been working together for thirty years."

"That's . . . that's a long time. I'm truly sorry this had to happen. Help me get a clearer picture of events if you would."

"Young man, I'd wrestle *lions* to help you catch the asshole who murdered David."

This person definitely *wasn't* my Grandma Mary. "Thank you. So Cunningham's appointment was over at four?"

"On the dot. I always buzz to make sure David knows."

"Did Cunningham remain in the sitting room to, ah, recuperate?"

"No. That light came on, but it went out right after. Eugene and David must have gone out the sitting-room door together."

"How do you know?"

"If Eugene had left *alone*, the sitting room would have been empty and the light would have gone out. Then when David left, I would have seen the light come back on as he entered the room and then go out again as *he* left."

"But how did you know Dr. Frankel was gone at all?"

She looked at me as if I needed some quick remedial instruction.

"Because David *returned* here five minutes later and went back into his office."

"You didn't realize he was gone until he got back?"

"No. Because they left *together* as I just told you."

"So you did. Did the doctor often leave by the back door?"

Mattoon glanced around the room slyly and lowered her voice. "Sometimes it was his way to . . . to get around the

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company's half-hour per session rule. You know—to walk with his patients as they went back to work. Usually, he'd remember to tell me if he was going out the back, but not always. He loved to help people, Mr. Gullintani, and now and then that's all he could think of."

"One last question. Did Dr. Frankel say anything to you when he returned from the bathroom?"

"No, he needs to rest his voice between sessions. He just gave me one of his sweet smiles."

"Thank you, Mrs. Mattoon, you've been very helpful."

"I don't see how, young man, but if you do, then I'm glad."

"Still suspect the secretary?" Bell asked dryly after she'd left the room.

"I'm crossing her off *my* list. But now I know how the murderer got into Frankel's office. Unfortunately there's a small problem with my idea."

Bell's eyebrows had skyrocketed. "Really? Don't keep it to yourself!"

"The good news is that you were right to call me in. This murder *was* done using a View-Net trick. The problem is that the trick should have been impossible."

"Keep going."

"Frankel never left his office. The man who came back from the bathroom wasn't Frankel."

"No, sir. I *asked* about that possibility and was told—by experts!—that it couldn't be done. Doesn't your company *guarantee* everyone a 'unique' appearance? That no one will ever look quite like anybody else?"

"Every company using View-Net makes the same claim. Otherwise you'd have the latest popular movie star staring you in the face everywhere you looked. As far as I know, the system is foolproof."

"So how can this be the explanation?"

"Because it's the only possible one. And besides, I didn't say the system was *genius*-proof."

* * *

For the first time, Bell looked at me as if Enhancement Incorporated might have sent him a nut-job rather than their top troubleshooter. I wanted to prove myself, but at the moment I couldn't imagine how.

"If you're right, mister, wasn't the killer taking an awful chance? Couldn't Mrs. Mattoon have seen who it was beneath the enhancement?"

"Not likely. Clients train themselves not to *look*; otherwise it would undercut the system. And the more expensive enhancements are hard to see through."

"But don't you think—"

"I hate to bring this up, Detective, but my *stomach* thinks it's past dinner time. Is there someplace we could grab a snack and sit and talk things over?"

He glanced at his wristwatch. "Right. Your stomach is still in Chicago. My wife would kill me if I spoiled my appetite for dinner—it's her night to cook—but I'll keep you company while you eat. What kind of grub calls out to you?"

Fifteen minutes later, we were seated in an odd restaurant named "The New Caribbean Zone." An entire fuselage of an old 747 Jumbo Jet with its wings cut off defined the back wall of the restaurant and an enormous open-air skylight made a nice playground for flies. A truly peculiar touch: the men's bathroom contained a goldfish pond. Bell mentioned that the original Caribbean Zone had burned down twenty years ago, but the new improved version still served the finest jerk-chicken in the city.

I would have enjoyed the food better if Bell hadn't asked an awkward question.

"How does this enhancement thing *work* exactly?"

"You said that as if you don't think much of my company's services."

"Far as I'm concerned, friend, enhancement is about one hundred eighty degrees south of a good idea. So far you seem like a decent man, Mr. Duke, but—"

"Gullintani. Better stay consistent."

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"Fine. But aren't you guys," he paused to take a sip of his vanilla Pepsi, "just plain *milking* people?"

"You're not being fair, Detective. The point is that *life* isn't fair. Why should the accident of a person's appearance mean such a difference to their lives? Often the difference between failure and success?"

"OK. But has it ever occurred to you that ugly people who *don't* sign up for your 'services' are now at a *hopeless* disadvantage? Not to mention anyone from a hated minority. I'll bet even a 'normal'-looking person can't compete these days without the damn V-Net. How fair is that?"

Not very, an issue that had been troubling me more and more lately.

"Look, I know the system isn't perfect, but what's the alternative? Are we all supposed to stay slaves to nature forever?"

"Maybe we should. Maybe it's more honest. And I *despise* the way enhancement has infected our basic *customs*; no one shakes hands anymore! Maybe we'll start shaking again when you guys figure out how to fake *everything* and get even filthier rich off it. And more and more public restrooms only have those stupid enhancement-mirrors so your clients can admire the way they think they *should* look. And they don't know it when they've got a piece of spinach stuck in their—"

"Look, Detective, I don't . . . completely disagree with you, but maybe we should stick to our current problem for now." He reluctantly nodded so I continued. "You wanted to know how enhancement works and that's a big question. I'll give you the two minute rundown and you just yell when you want more details."

"Fire away."

I downloaded the company lecture and started reading the words in my heads-up display. "At the turn of the century, researchers in Boston were trying to cure blindness in people with conditions such as macular degeneration and diabetic retinopathy. Elsewhere, scientists were on the verge of developing an artificial retina, but this team took a different road. They learned how to directly induce signals into the optic nerve and—"

"Whoa. I just need to know what you *do* to your clients—physically—along with a basic idea of how the system *works*. Keep it simple."

Lecture aborted. "I'll try. After someone signs up, we take DNA samples and use them to clone duplicates of their choroid cells. The choroid is a membrane behind the retina. Then we stuff tiny goodies into those cells, circuits and electromagnets you wouldn't notice without a good microscope. Incidentally, that's where Enhancement Incorporated blows away Larger Than Life and the others: better goodies."

"You'd better pray they never put you in *sales*."

"Point taken. Anyway, we inject the client with the modified cells and twiddle our thumbs until the cells have implanted themselves in the right spot. Eventually, the choroid membranes become *arrays*: receivers of View-Net signals and translators of those signals, turning them into extra optic nerve impulses. The choroid-array also tells the V-Net what the client is looking *at*."

"How?"

"Head position, movements of the eye-muscles, and subtle deformations of the eyeballs caused by changes in lens shape. It's so damn sensitive that if your eyes are pointed at a nearby object but focussed on a distant one, the View-Net knows it."

"When is *that* useful?"

"If someone within three hundred yards of my belt-module tries to see me in a hand-held mirror, all they get is a blur."

"Jesus! But in general, how does the View-Net knows what to send and when to send it?"

"In the *second* half of the member-

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ship procedure, various muscle cells are cloned; but this time the goodies inside are strictly transmitters, each with a unique 'fingerprint.' When we're done, the client has sixty-two 'nodes' distributed around their bodies. You've probably noticed that everyone on the Net wears modules? Like this one on my belt, but smaller?"

"I thought those were battery packs."

"They are, but they have other functions. They're sensitive to nodal-transmissions. The modules relay the information to a central computer and the computer uses the New Global Positioning System to track each client's location and pose. When fellow members are within two hundred yards of each other, the computer sends continual messages to the modules. The modules stimulate the members' optic nerves, providing a programmed illusion of what the other person looks like, but making the illusion reasonably consistent with each person's real position, posture, and facial expression. Naturally, it's the client who decides how they should appear to other people in the system. . . ."

"Explain *this* to me: client number one makes himself six inches taller and picks up, say, a pencil. Does client number two see that pencil?"

"Yes."

"Where? In a hand that's six inches higher than the real one? Don't try to tell me you've got those 'nodes' hidden in every damn *pencil* in San Francisco!"

"Enhancement isn't superimposed *over* normal sight, it streams with it. Visual reality gets . . . blended. The new member goes through some training and adjustment before they can really—"

"I've heard that everyone on the V-Net has to take potassium supplements?"

"Yeah. There *is* a down side to all the extra nerve stimuli. Electrolyte balance is crucial at the nodes of Ranvier—those specific spots within a nerve's myelin sheath where potassium is exchanged for sodium to—"

"Whoa! Enough! Finish up your dinner and we'll head on back before the Delton people pack up for the night. I want you to meet my three main suspects. If you're not going to eat those fried plantains, I'll take 'em."

If I had to pick a murderer using gut-instinct alone, I would have cheerfully picked William R. Greenfield.

Bell and I were back in Dr. Frankel's anteroom, conducting brief interviews of the three patients who'd followed Dr. Campbell to the recent murder scene and—accidentally or deliberately—muddied the trail.

I disliked Greenfield from the moment he said hello. It was the way he said it, as if he was uttering a profundity far beyond our grasp.

Greenfield resembled a small weasel, and his class-three enhancement made him look like a bigger weasel. The "mask" did have one exotic feature: he'd made his eyes unusually large and given them cat-like pupils. Those green eyes stared at me, somehow conveying the idea they'd seen Nordic gods before and were getting tired of looking at them.

"I don't think there is anything I can or would care to add to what I've told you already, Detective."

"How did you find out Dr. Frankel had been stabbed?"

"Come now, Detective, now you're asking me to *repeat* what I've told you repeatedly."

"Humor me."

"When I saw Dr. Campbell running across the room I knew something was wrong. Barry Campbell isn't built for running; I think we can all agree on that. I'm a concerned citizen, so I followed him. It's that simple."

He stopped talking and favored us with a smile that made me happy when Bell dismissed him.

The next suspect was a woman named Gloria Gonsolez who used her level-two enhancement to hide a constant facial twitch. Level two is a bit

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transparent to make an ideal disguise, but View-Net clients school themselves to disregard a person's real face as a matter of etiquette.

"Why are you talking to me again?" she snapped at Bell before he had a chance to speak. She seemed tense enough to have murdered a dozen therapists and did everything she could to avoid looking at me.

"I only wanted my associate to *meet* you, Ms. Gonsolez. This is Rig Gullintani and he's going to dive right to the bottom of this whole business."

"How nice for all of us," she hissed, still not looking at me. "Can I go now?"

The last suspect was Eugene Cunningham, Frankel's final client on the day he was killed. Cunningham had a classic, level-three enhancement that covered up his small, round face with a far handsomer one. The "mask" had one amazingly exotic feature, however. I'd never seen anything like it. An invisible sun seemed to be shining on his enhanced head in an . . . astronomical manner. I mean his face had phases like the moon, but faster. At the moment, it was about a quarter full but the motion of the terminator line was relentless and quite noticeable. In about fifteen minutes, I estimated, his head would be full.

Cunningham seemed utterly depressed. He stared down at his feet and waited for someone else to speak.

"Thank you for coming, Mr. Cunningham," Bell said gently.

"Eugene. Call me Eugene—I told you that before. 'Cunningham' is my *father's* name." His flat voice had curdled on the word "father."

"Sorry, Eugene. Could you tell us why you followed Dr. Campbell in here the day of the murder?"

"I saw Bill and Gloria following Barry so I had to see what was going on. Look, I'm sick about all this. David was my only real friend in the world. I hope you don't think I had anything to do with—"

"You *aren't* a suspect," Bell lied. "Don't worry about *that* for a second."

"All right then. I've got things to finish up. . . ."

"You can go now. Maybe we'll talk to you later and see how you're doing."

"David was my only friend in the whole world," Cunningham repeated as he left the room.

Bell and I stared at each other grimly and he was the first to break the silence. "It was one of those three. I know it. I'm just praying it was that Greenfield smartass. Well? Did your *special gear* tell you anything?"

"All three had a clear, unbroken history with the View-Net. If anyone somehow . . . borrowed Frankel's 'mask' it didn't show up on my display."

"I don't suppose that computer of yours keeps track of a guilty conscience?"

"Don't I wish. Maybe I should—"

A woman whose bright red natural hair had been enhanced with tiny green flames walked briskly into the room. "Sorry to interrupt, Detective," she said crisply. "I'm Angie Murphy, Ms. Benington's assistant." She turned to look directly at me. "Mr. Gullintani?"

"Yes?"

"Ms. Benington was wondering if you might be able to take a short meeting with her before she has to leave?"

I glanced at Bell who passed the buck back to me via a shrug.

"Why not? Could you tell her I'll be there in five—wait a second!" A striking change of colors within the ion-sculpture had caught my eye and my curiosity.

"Isn't this rather wasteful?" I said, pointing at the Plexiglas cube. "That thing takes a lot of power, and if no one is using this waiting room, why is it still running?"

Murphy nodded sadly. "Clarice insisted. Kind of a memorial. It was Dr. Frankel's favorite—he *loved* that thing. The boss gave it to him two years ago as a gift but he kept it on Clarice's desk so he wouldn't get distracted during the

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sessions. I remember how he could never even walk past it without . . ."

Her voice choked off and tears spilled down her real cheeks.

"I'm sorry for being so damn . . . *unprofessional* . . . sometimes all this catches me by surprise."

As for me, my heart was racing. "That's quite all right. Sounds like a lot of people cared for Dr. Frankel."

"We all did." Not *all*, I thought. "He was a wonderful man, Mr. Gullintani; I wish you could have met him."

"Me too. Do you happen to know if Mrs. Mattoon is still here?"

"I believe so."

"Kindly convey my regrets to Ms. Benington. I need to speak with Mrs. Mattoon before I do anything else."

"Certainly, sir. As you wish. I'll send her right in."

Clarice Mattoon regarded the ion-sculpture wistfully as she considered my question.

"Definitely," she answered at last. "David *always* stopped to enjoy his sculpture whenever he passed my desk; sometimes it was hard to pry him away. Wednesday afternoon was no exception."

"So immediately before entering his office for the final time, he stopped to admire his treasure. You're sure of that? Can you give me an idea of where he was standing?"

She moved to within a few feet of the cube. "I can show you *exactly*. At this very spot as usual. Look at this! He stood here so often, it left a permanent indentation in my carpet."

I tried not to show any excitement. "Thank you *very* much, Mrs. Mattoon."

"You're quite welcome, I'm sure. But why is this important?"

"I'm not sure it is, but we'll let you know if something comes of it."

Bell allowed half a minute to pass after Mrs. Mattoon had departed before turning toward me with a no-nonsense scowl. "All right, mister. You've been *coy* long enough. You got something and you're going to tell me what it is."

"The first time I was close to the sculpture, not even as close as Frankel was standing, three minor error-messages appeared in my heads-up display. Without the display, I wouldn't have known anything was wrong."

"So?"

"Assume for a moment that my theory is right and also that *your* theory is right: that the killer is one of the three people we interviewed today. One of them managed to sneak into the View-Net's data banks, borrowed Frankel's 'mask,' wore it into the therapist's office, and murdered Frankel."

"Hold up. In this joint theory of ours, where was the killer when Clarice found the *body?* No one was in the sitting room."

"Hiding behind Frankel's chair."

"Jesus! That would take balls big enough to wreck buildings!"

"Isn't it obvious that our killer loves to toy with people's heads? Why else create this mystery in the first place?"

"But how does your mastermind expect to *leave* the office without Mrs. Mattoon noticing? Remember, even if he went out the back way, the indicator light would have flashed."

"That's a matter of planning and the killer observing people's routines. We know that every workday at half-past four, Mattoon told Frankel it was quitting-time. What if Dr. Campbell is another creature of habit with a regular snack-time at four-thirty? Should be easy enough to find out. Our man Greenfield implied the good doctor was somewhat . . . heavyset as I recall."

"The man could be a damn Sumo wrestler—if he whipped himself into shape. So you're thinking the timing of the murder was planned around Mattoon having to go fetch the doctor?"

"Yes, but let me get to the good part. After the murder, the killer must have used that mysterious pipeline into the View-Net to replace his or her own

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'mask' and then normalize records for the day."

"And?"

"And our mastermind had imitated Frankel to perfection, even standing in the right spot to admire the ion-sculpture. Error messages—nulls—would have appeared on the killer's records and they *wouldn't have been erased in the rewrite*. 'Nulls' are only little holes in the data flow and, in our system, there's no reason to erase *holes*."

"So the killer may have left footprints after all?"

"Exactly. And since we know the precise time the fake Frankel returned to the office, it shouldn't take me long to find any such footprints."

"Excellent!" Bell's eyes shone avidly. "Excellent! Should we corral our three candidates again?"

"Not yet, Detective. My module has a little alphanumeric keyboard so I can access someone's records without their presence. Give me five minutes. And I'll tell you what: I'll start with our favorite suspect."

Figuring out *how* to catch the murderer had been a thrill: the thrill of the hunt. Actually catching him just made me feel sick.

I could never do Winchester Bell's job.

When we cornered William R. Greenfield in his cubicle, I felt an almost magnetic revulsion and desperately wanted to be somewhere else. Here was a man who'd actually *butchered* a human being. Bell, on the other hand, was palpably eager to get closer to Greenfield, to grab him and make sure he was punished.

"What do you want," the weasel snapped.

"You," the detective stated softly, flashing me a warning glance. Bell had said he might try to rattle out a confession. "We have proof that *you* are the murderer of Dr. David Frankel. You have the right to remain—"

"*What proof?*" Greenfield's real face was rancid with anger.

"Mr. Gullintani?" Bell said. I took the cue and began describing the evidence.

"I *get* it," Greenfield spat before I'd even warmed up. "*I'm* not a moron, you moron. But what you're saying is bullshit. No one can break into the View-Net database; it's sealed tighter than the CIA's black files."

I nodded soberly. "I've been thinking about that. It occurred to me that someone *could* break into the system if they'd been involved in creating the system in the first place and had put in a . . . secret door *at the time*. And since Delton only hires geniuses, the kind of minds who built the View-Net, just possibly a View-Net designer might wind up working here? Someone with a secret door could use it for . . . lots of interesting things. Many of the most powerful people in the world have intimate secrets locked up in that database."

Greenfield just glowered at me.

"So," I continued, "I asked for a photograph of you and faxed it off to . . ."

"And my supposed motive for the *murder?*"

"You must have a conscience, ah, somewhere and it must have been bothering you. So you signed up to be one of Dr. Frankel's patients. Then, at some point, you revealed a little too much and the doctor became a threat. So on Wednesday, you—"

"Shut up!" he yelled. "Just shut up! I've got proof that I didn't do it. Right here on my desk. Look!"

With his right hand, he shuffled through papers in front of him, withdrew one, and held it up triumphantly. I have to admit, he'd managed the stunt very smoothly; even Bell was caught offguard. It took me a few seconds to notice the thirty-eight caliber pistol in Greenfield's left hand.

"Here's what's going to happen *now*, gentlemen," he said. "Everyone is going to move very, very slowly. Raise your hands, both of you, and put them on top

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of your heads. Then we're all going to—yaahh!"

Pain had forced his eyes closed and he even tried to shield them with a forearm, but it was already too late. As I was obediently raising my hands, I'd brushed against the intensity control of my belt-module to give Greenfield the biggest, brightest smile he'd ever seen. *Really* bright. An oxyacetylene torch couldn't have done the job better. Naturally, I was immune to the effect and Bell couldn't see it.

I reached out and snatched the gun. The detective reacted instantly—rushing around the desk, throwing Greenfield on it facedown, and handcuffing the weasel before he could move an inch.

"How'd you *do* that?" Bell asked me, panting. "What just happened?"

"Did I ever tell you the meaning of the name 'Gullintani'?"

"I don't think so."

"It means 'gold-tooth.' Heimdall supposedly had shining, golden teeth. My technical staff liked the idea and turned my mouth into a . . . secret weapon of sorts. Sometimes, Detective, it pays to be a god."■

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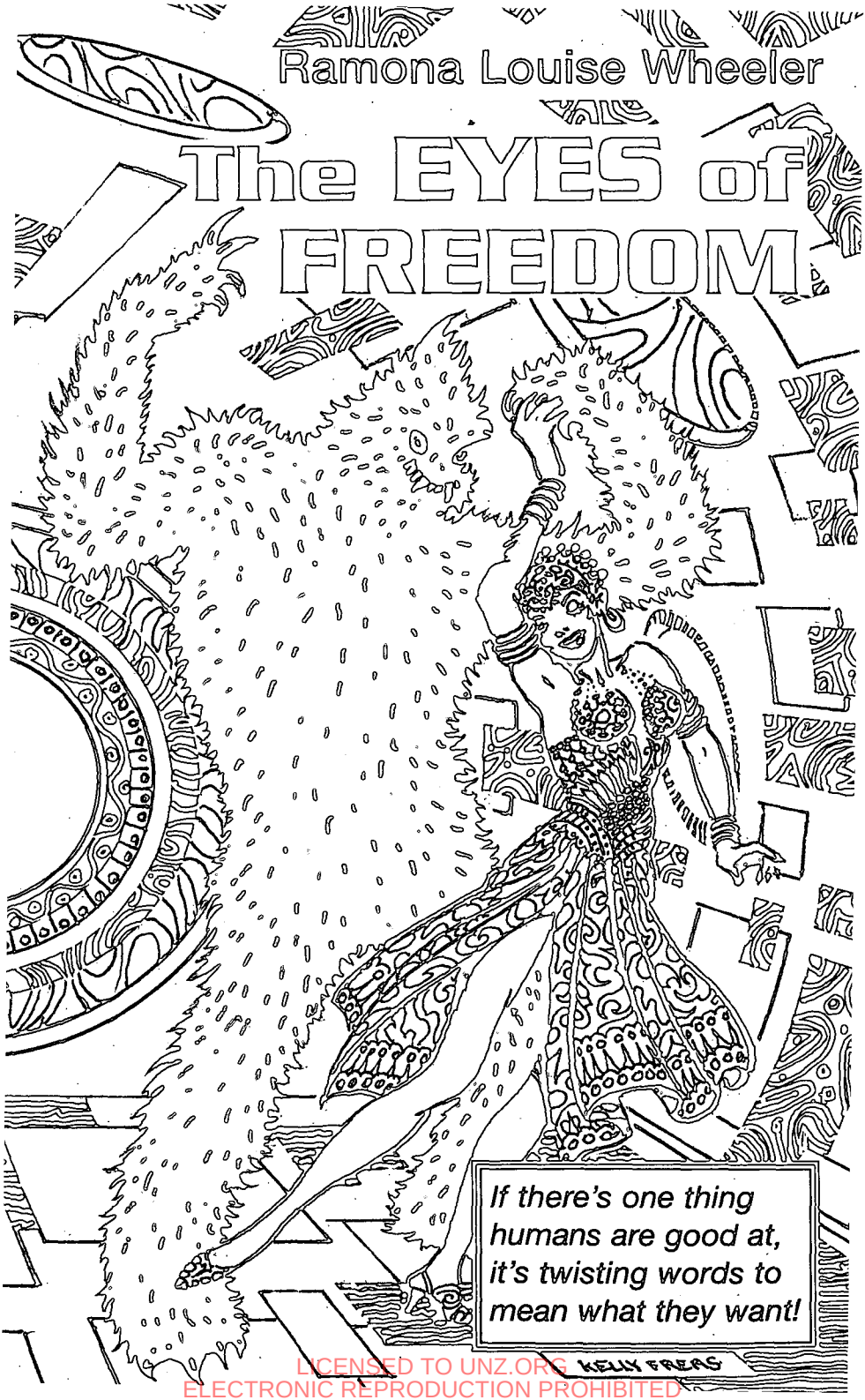
Ramona Louise Wheeler

The EYES of FREEDOM



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"Did you find any chewing gum?" Rokey asked his partner, Ray Harris, by way of greeting.

Rokey was leaning wearily against the side railing of the bar, drink in hand, as the tall, fair-haired Earthman appeared out of the smoky murk of the nightclub. The Wozurn's black fur shone ruby red in the house lights, but the way his ear tips were drooped over made it clear that the red burn in his copper-colored eyes was not from the lights.

Ray Harris dropped his own irritation immediately. Clearly he had left Rokey waiting here for too long, with time for a few too many drinks. "Yeah, I did, finally," Ray said. "It'll keep me until the next stop." He made his tone light. The Earthman had traveled with his alien partner long enough to recognize the signs that he was pushing the envelope of the older man's patience.

Rokey drained the last of his drink, set the glass down sharply on the bar. "Then let's get out of this gas station."

"I couldn't find a postcard anywhere," Ray added quietly as they went out.

Rokey twitched the long whiskers on one side of his face in annoyance, but said nothing.

Someone was making a fortune with this fuel-stop station, but they were clearly not investing it in decor or ambience. There were few buildings anywhere on the planet, primarily just the spaceport complex behind them and the huge hydrate processing plant that was the only reason for anyone being here. There was breathable air, no native sentient race, and a half dozen intraspace windows that linked distant star systems. Places like this were known as "zip links," and rarely had more than a fuel station, hotel and bar—a stopover for travelers rushing about in the Galaxy. Ray and Rokey were not rushing, but neither man wanted to linger here. Ray Harris hated being on planets. Real gravity made him nervous. Rokey didn't mind planets; he was just bored with the place. There was nothing here but white concrete and cheap plastiment. All he could smell was the overwhelming, permeating odor of the methane-hydrate plant that dominated the landscape.

Sunlight on the open landing field was dazzling. Ray pulled the brim of his hat down against the glare of light. Rokey put his hand out, palm up, and snapped his fingers. Rokey was clothed only in his own native fur, and thus had no pockets to keep things in. Ray took a case out of a jacket pocket and dropped it in Rokey's hand. Rokey tapped the case and it opened, folding outward and automatically refolding itself into a pair of sunglasses with an elaborate design shaped to fit Rokey's Wozurn facial dimension. The side pieces anchored themselves in the dense fur of his cheeks. The mirrored lenses made his alien expression completely unreadable. It was early afternoon, and the shadows were short and hard. The two men set off for their starship, walking in silence until they turned the corner of the spaceport building to the hotel front.

Rokey stopped and gestured. "Maybe they have postcards in the hotel lobby?" he suggested to Ray, pointing to the smoked-glass double doors of the hotel entrance.

"Yeah. Thanks," Ray said, relieved that Rokey seemed to be over his annoyance.

Captain Ray Harris collected postcards. It was not an art collection. It was the only "captain's log" he kept of the travels of his starship freighter, *Yankee Shadow*. Ray bought a card at every world where they landed, dated it, and tacked it up in the ship's main corridor. His mother had done the same on the starship freighter that had been Ray's birthplace and first home. His postcard diagram of stellar routes was his only indulgence in sentimentality. The postcards were arranged by intraspace window routes. Each card was surrounded by cards from the systems linked to it by

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the intraspace cracks between stars. There were several hundred, radiating out from the central card of Auruma, the system where his parents' ship was registered, where he had gone to school, from where he had been exiled by interstellar military warrants and interstellar policy. Several large domains of interstellar space were represented. Most of the cards had been chosen by Ray's personal taste: intense sunset colors and city scenes at twilight, alien landscapes with wide borders of sky, dominated by flame oranges and cool chlorophyll greens. Some had been chosen simply because they were the only ones available from colony worlds too small or too new to have more than one postcard to advertise their existence. Usually these were sleazy four-color 3Ds of colonial families lined up in front of the sprawling fuelstation-motel-trading-post structure that was the only architecture on that entire round world. Many were of sleekly anonymous aliens posed among interstellar furnishings. A few were careful holograms of exotic alien artworks emblematic of their cultures in a single gesture. The date in Universal Civil Time was neatly written in the upper right corner of each. Return trips were represented by columns of postcards, one above the other. The wall display had been the start of many pleasant conversations, and stored a lot of memory. Sometimes on the back of the card he would write a name, although it was as often that of a new enemy as of a new redhead. The *Yankee Shadow* kept her own internal machine records of their travels. This was the only record Ray cared to keep. Rokey did not care at all about keeping records. He just wanted to keep on the move.

Rokey followed Ray into the hotel lobby.

Inside they found the standard hotel style, hushed elegance, dim lighting and generic greenery. Curved staircases arched up in graceful lines at each corner and along the back wall. Starmen tend to distrust elevators because people get trapped in elevators. Someone who lives life hurtling through space at unthinkable, incalculable speeds often finds the prospect of hurtling along inside a solid building on solid ground unbearable, so spaceports have lots of stairs. A starman trusts only his starship and his body, and he trusts his starship first; his body, after all, is only human.

The concierge did not look up from his monitor screen when Ray and Rokey walked up to the desk. There was a neat row of brochures, flyers and ads on the counter, and also a stack of postcards. The picture was garish, a flat photo of the hotel building itself with the processing plant visible behind it.

Ray took the top card off the stack. "How much?" he asked the concierge. He held the card carefully, gloved fingertips touching only the edges.

The young Earthman at the desk put out a slender, overly manicured hand and took the card back from Ray, returning it to the stack. "Postcards are for the convenience of hotel guests only, sir," he said with cold politeness. He did not look at them.

"I just want to buy a postcard. Where else could I find one?"

"These are the only postcards available, sir."

"I guessed that much. I would like to buy one."

"Postcards are for the convenience of hotel guests only, sir." His politeness was coldly professional.

"So, in order to buy one little buck-and-a-half postcard, I have to rent an entire room?"

"Yes, sir."

"And these are the only postcards in town?"

"Yes, sir."

"And this is the only town on the planet."

"Yes, sir."

"I guess I'm not going to mind forgetting that I ever came to *this* place," Ray said as he turned away to go.

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"Good day to you, too, sir." The concierge's politeness remained unruffled. He continued his deep study of his monitor screen.

Rokey leaned an elbow on the high-topped counter and picked up one of the postcards, examining the image on it with exaggerated care. "Is the picture supposed to be of the front of *this* building?" he asked. "On here it looks so clean."

The young man took the card and returned it to the stack. "It's an old photograph, sir."

Rokey caught up with Ray going out of the hotel lobby.

"A very forgettable place," Ray said when they were once more out in the hot sunlight.

Rokey dug into the long fur over his hip and pulled out the postcard he had concealed there. "But, just for the record," he said as he held out the card to Ray, "let's put this up to remind us never to come back here."

Ray took the card with a laugh. "You old pirate! Where'd you get that?"

Rokey shrugged. "That kid is not as good at his job as he thinks he is."

Ray was pleased. He put the postcard away in the breast pocket of his jacket. Ray's fancy, well-tailored black jacket had many pockets. "Can't turn my back on you for a second, can I, old man?" he said fondly.

The police were waiting at the foot of the ramp to the *Yankee Shadow* by the time the two had walked across the field to their ship. Both men groaned when they saw the police vehicle parked there, but they continued on. There was only one way to get back on board their ship.

The policemen wore hard-mirrored face-guards over impassive faces. Their police uniforms had the ill-fitting look that is universal to uniforms, and their police weapons were equally universal and much larger than necessary. Ray tried to put on a brave, innocent-looking smile as they approached. Rokey just tried to keep his hands at his sides and in plain sight.

"You broke the law," said Judge Whythe.

"It's a postcard. . . !" Ray exclaimed, and then hastily added, ". . . Your Honor. Ma'am. We'll pay for it, obviously."

Judge Whythe was also an Earthling, and looked much too young to hold such an important position. She sat behind an elaborate desk that had been hand-carved from nearly transparent wood, as though cut from a glass tree. The office was elegant and expensive, a marked contrast to the utilitarian austerity of the fuel-station buildings outside. She was an elegant woman, with her fingernails grown out long like curved claws painted a vivid red. She had sharp gray eyes that studied Ray carefully as though she were admiring a painting or a fine animal. Through the transparency of the desk, they could see that her fingers, clasped demurely in her lap, were twitching in suppressed excitement.

Rokey broke in, "We'll even pay for a hotel room, if that would help, Your Honor." He hated sobering up overnight in jail, and their long morning's wait in the judge's anteroom had done little to improve the bad taste in his mouth that this fuel-station stop had become, but he had enough experience with bureaucracy that he knew what behavior was needed. "We had intended to pay from the beginning, but the young man . . ."

"That's hardly the issue," judge Whythe interrupted sternly. "We have people from every walk of life in the Galaxy going through here, gentlemen. I know what happens to fuel-station crews who let their discipline slide. You starmen are just passing through. We have to live here."

"Yes, ma'am," Ray said. "Your Honor, ma'am." He had a sinking feeling that this was going to be one very expensive postcard.

"But I have a proposition, Captain Harris," she said, "that could get us *both*

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out of . . ." she paused, even her restless hands, and blinked calmly at them, as if making a final decision. "Out of our little difficulties of the moment," she said at last.

That knot in the pit of Ray's stomach tightened further.

"There is a police lieutenant here who has to transport a prisoner to a planet called Freedom Foundation, a colony at the outermost edge of Earther Space. I don't have the facility to provide transportation. This is a fuel station. They've been here for months." She paused, flicked her tongue tip across her painted mouth. "And at my expense, since it is official business."

"And this little side trip to Freedom will clear us over the theft, Your Honor?" Ray asked.

"Completely." She paused, and finished with a raspy chuckle. "I'll even let you keep the card."

Rokey sighed, and the two men shared a quick glance. Ray shrugged. "Well, we don't usually carry passengers, but I guess the *Yankee Shadow* is going to Freedom, ma'am. Your Honor."

Freedom Foundation was an old colony world of Earth, from the earliest days of explosive immigration to the stars when anyone who had an idea of how Utopia was done could find his own planet to play on. The world of Freedom was a long, long way from home. The journey would require two months in Intraspace to get there and deliver their passengers, and another three weeks to the next port after that to get on with their lives. It wasn't quite jail, but they were stuck with their passengers for the next two months.

It was not strictly true that the *Yankee Shadow* carried no passengers. There was a spacious and well-fitted guestroom that was originally designed as the captain's quarters. When Ray Harris first signed on with the *Yankee Shadow* an Earthman named George Humphrees was captain, and Ray took the guestroom. Even though Ray later inherited the ship, he did not change quarters when George left.

Ray and Rokey both felt that carrying passengers just invited trouble. Ray tried the final resistance of insisting that the policeman and his prisoner share the guest quarters, but Lieutenant Stephen Poyser was adamant that his own security would be jeopardized if he could not lock the prisoner away someplace separate from himself. The prisoner was a woman, a movie actress named Regina Renown who was going home to face trial, and Poyser felt it was inappropriate for them to share quarters.

Judge Whythe agreed.

Rokey stayed out of the debate. He was the one who had lifted the postcard, after all, and he was aware that Ray said nothing that indicated he blamed Rokey for their present annoying circumstance. Rokey rather suspected Ray blamed himself, since Rokey had only taken the card for Ray's sake.

Ray refused to watch the passengers come on board, but sat up in the bridge pretending to be busy while Rokey acted as reluctant host.

Lieutenant Poyser carried two sinister black cases and an officially monogrammed garment bag. He was tall and straight and moved with the rigid, overly cautious manner of a man who knew he was out of place. His uniform had too many buttons, with enough braid on the cuffs and collar for an admiral. His satin cummerbund gleamed in the sun. The entire uniform was white, from his pointed, knee-high boots to the sharply brimmed cap, immaculately white to match his startlingly white skin, his white face topped with hair so pale a blond as to be transparent in the harsh sunlight of the landing field. He looked like the ghost of a policeman out in the sun. Poyser also wore a white-handled stingblade at his hip, carried in a pearlized sheath. Stingblades were customary police artillery, shooting a nerve-stunning jolt of elec-

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trons in a carefully controlled stream that could stop one cold from a distance and never leave a mark. He also had an elaborate piece of hardware mounted on his right shoulder—a short, white, barrel-shaped mechanism that swiveled nervously, scanning the surroundings. That, however, was not a weapon but a portable security camera. This colonial policeman was taking serious precautions over the prisoner in his custody.

All this made Rokey curious about this prisoner, Regina Renown. Rokey was immediately impressed by the dignity of the woman walking slowly up the ramp beside Poyser. She carried no luggage, just a simple handbag with a shoulder strap. Her right wrist was handcuffed to one of Poyser's suitcases, yet she strolled along as casually as if she were on a walk with her dog. Regina Renown was taller than Poyser, voluptuously curved and athletically muscled, a fine, big woman. She moved with a sensual, slow grace that communicated charm with every gesture. She had no hair, and her ears were long, dangling heavy earrings thick with pearls. Her face was narrow, receptive, her neck long on sloping shoulders. She was completely tattooed in an exotic technical style, every inch of her skin vibrant with micro-etched iridescence, with a rainbow sheen that was every color at once and shifted through the spectrum as she moved. She wore a fairly modest suit of soft gray, with a long skirt that left her ankles bare, but the color was clearly chosen to accentuate the richness of her artificial coloration, like spring flowers seen blooming against a rainy sky. Her blue eyes were very large, and although seemingly tranquil, amusement was clear in their blue depths.

Lieutenant Poyser did not introduce her but said only, "Show us to our quarters, Mr. Rokey."

Rokey nodded to the woman. "Afternoon, ma'am."

She nodded to him solemnly as she went past, but showed a flash of that strange humor in her eyes. Rokey wondered what the joke was.

"I have nothing against Earthlings," Ray complained to Rokey. "I mean, my parents are Earthlings."

"Your parents are descendants of colonists of Earth," Rokey spoke with glum resignation. "Just like Freedom Foundation. There's a difference."

"There better be a difference." Ray stopped his restless pacing and sat down at Rokey's desk, sighing heavily with mock dramatics. "I mean, I dragged you into this end of space because I thought you would be . . ." He sighed, searching for words.

"Less visible," Rokey finished the thought for him. "It was a good plan then, and it is a good plan now. There aren't enough InterPol agents in this quadrant to hold a tea party, much less bother with a stray Wozurn. This is merely an annoyance, Ray. It's not like getting arrested for real."

Neither man spoke aloud the reasons why they were traveling in places where Interstellar Police were a rare commodity. The reasons had become part of the fabric of their lives.

Ray stretched his long, lean legs out and crossed one foot over the other, switched them, and then sat staring down at his boot tips with a frown. "At least you didn't get bumped out of your own quarters," he muttered.

"But I do have to live with *you* in here with me for the next fifty-nine days," Rokey said. He was lying flat on his back on his oversized bed, arms folded behind his head and staring at the blank trideo screen that was the main wall of his quarters. "I am likely even less thrilled about this than you."

"I don't snore."

"I only snore when I'm asleep," Rokey pointed out patiently.

Ray sighed. Rokey was an insomniac, and sometimes went for weeks without really sleeping.

Their uninvited guest, Lieutenant

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Poyser, appeared in the entry. He was still dressed in full official uniform, cummerbund, boots, stingblade and all. He paused, posing himself in the entry foyer to Rokey's quarters and glancing around as though seeking his audience, clearly accustomed to having his orders followed without question. "Gentlemen, it is necessary that I place a Freedom Eye in the entryway of these quarters. I must be prepared to monitor my prisoner anywhere in the ship should she escape."

"A Freedom Eye?" Ray said. "What's that?"

"An automated visual monitor." Poyser held out his hand to show them. It was a small, egg-shaped trideo camera with a lens at one end and a fancy suction cup mount at the other.

"We're in Intraspace!" Ray exclaimed in protest. "Where can she go?"

"That is not the issue," Poyser said. "I must keep her monitored at all times."

"What could she do?"

Poyser regarded Ray with calm, gray eyes. "I will not know unless I keep her monitored."

"You put an camera up anywhere near our quarters and you will be monitoring us," Rokey spoke up. "That is not acceptable."

"That is definitely not acceptable," Ray added. His face tightened and he glared at the police lieutenant. "Are you putting those things up in her room?"

Poyser nodded curtly. "I must keep her monitored at all times."

"Then hang one around her neck or pin it to her purse," Rokey said, pushing himself up on one elbow to look directly at Poyser. "But you keep your damned Eyes to yourself! You are not putting them up in my ship—Lieutenant Poyser, sir!"

Poyser's white face tightened, his eyes narrowed, but he said nothing. He turned and went out.

Rokey lay back down with a heavy sigh. Ray went back to glaring at his boot tips.

"Pick a movie," Rokey said. "But fix me a drink first."

Lieutenant Poyser came back a few minutes later, upset that there was no way to lock Regina into her quarters. Ray decided not to mention that the *Shadow*'s security systems could magnetically seal any door from the bridge if necessary. He did not feel this qualified as the right kind of emergency. Rokey didn't, either.

Poyser's heated look intensified. "This is a most awkward situation, Mr. Rokey."

"You said it, Lieutenant." Rokey smiled.

Ray tried not to grin.

"In that case Miss Renown will have to be handcuffed to something when I am sleeping." Poyser spoke with overly deliberate calm. "That is the only way to insure my safety."

Ray's face went cold. He sat up straighter, folding his arms across his chest. "You are not handcuffing anybody to anything on my ship," he declared. It was clear that he meant it.

"This is a starship," Rokey broke in and explained patiently, "You will notice that there is nothing you could cuff her to, anyway. Anything of a shape and size to fit a handcuff around would also be of a shape and size to become a dangerous object in an emergency. Starships get flung around sometimes." He recalled Judge Whythe's words. "You're just passing through. We live here."

"What makes Miss Renown so dangerous, Poyser?" Ray wanted to know.

The lieutenant paused to select his words. "She is a criminal. I have no way of knowing what she is capable of."

"You have no way of knowing what I'm capable of, either."

"No, Captain Harris. I do not."

"She's some kind of big criminal." Ray said. "What did she do?"

"High treason," Poyser replied promptly. He looked as though he would say more, but then turned and strode out.

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On the strength of just how annoyed Lieutenant Poyser would be by it, Rokey decided to invite Miss Renown in to watch movies with him and Ray. Watching movies was the primary way Ray and Rokey passed the time during the enforced isolation of Intraspace travel. Rokey's movie collection rivaled that of some planetary libraries.

Rokey tapped gently on the controls and announced himself in the door speaker.

"Come in, please, Mr. Rokey," she called.

He found her stretched out gracefully on the bed, raised up on one elbow, regarding him with lazy calm in her very blue eyes.

"You have a most fine starship, Mr. Rokey," she said to him. "I think it is more pleasant here even than that hotel we just left."

"Thank you, ma'am." Rokey was struck again by her calm and slow grace. "I wondered if you might like to watch a movie with us? Ladies' choice."

Regina laughed softly, tilting her head back and letting her eyes close with a luxurious gesture of delight. "I'd be thrilled, Mr. Rokey. I have tried to treat this all as an occasion to get a rest, to free myself from the bluster of work, but I must tell you that policeman has me bored to abstraction!"

"I know what you mean, ma'am," Rokey said with a twinkle. "He sure makes me tired all over."

She laughed again, and stood up from the bed with a smooth, lithe gesture. Rokey saw then that Poyser had cuffed her hands together. Her long wrists were quite slender, and the solid plastic bands were a harsh blackness against her iridescent flesh.

Rokey's eyes went red with a sudden blood pressure rise of anger. "Excuse me, ma'am?" he said, pointing to the handcuffs. "The captain told Poyser no cuffs. Not on this ship."

Regina held up her hands in a helpless gesture. Her eyes sparkled with that same solemn amusement Rokey had seen when they first met. "What can I do?" she said. "He is the Law, and I do frighten him so. He says I must wear these when he is asleep."

"And the captain told him 'No,'" Rokey said as he gently took her elbow, ushering her out to the corridor. "And when Ray says 'No' he means 'No.' Well, if Poyser's asleep just now, let's not disturb him. If you would just come with me to engineering for a moment, we can get on with our movie."

Rokey stuck his head in the entry to his room as they went by and called to Ray, "Get out here, mate. We need a hand with this."

Anger showed clearly in Ray's face when he saw the handcuffs on Regina. "Right, mate!" he said. "I know just the thing."

They took her below decks to engineering, where Rokey kept a variety of tools and supplies.

The handcuffs were official police issue and not to be casually broken open. Ray tried first to open the cuffs using a fancy set of electronic lock picks he had inherited from the previous captain of the *Shadow*, George Humphrees but, despite his patience, without success.

"We might have to lift Poyser's keys," Rokey suggested finally.

"And a fingertip along with it," Regina said with a light chuckle. "He uses a genetic touch code for the lock."

Ray sighed, and began repacking the lock-pick kit. "That is out of my league, ma'am, I'm afraid. I'm only an amateur. I do doors, not police equipment."

Rokey pulled out a heavy-duty laser saw to cut the binding between the cuffs, but burning through the plastic heated the material too much to use safely for cutting the bands on her wrists. "For the moment that's the best we can do," Rokey said. "I'm sorry."

"No matter," she said merrily, raising her hands up and shaking the wristbands as if they were jewelry. "I can live

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with this." She spread her arms wide, "This is enough freedom to suit me."

Ray and Rokey exchanged troubled glances. Rokey shook his head. "Then let's get on to that movie. I could use another drink."

"I wouldn't mind one myself," Regina said.

When Poyser woke up, many hours later, he found them all in Rokey's room, the trideo screen alive with a deep-jungle movie in black and white. Ray had fallen asleep in a pile of pillows on the floor. Regina had also fallen asleep, curled up against Rokey on the big, wide bed. Her hands were folded under her head, so Poyser did not notice what they had done to the handcuffs.

Rokey was still awake. As an insomniac, Rokey was long accustomed to watching movies while other people slept around him. He ignored Poyser at first, but the policeman strode over to stand at the foot of the bed, blocking much of Rokey's view of the screen.

"I will not have you men fraternizing with my prisoner, Mr. Rokey!" he declared, raising his voice to be heard over the music swelling up from the screen.

"Shush!" Rokey hissed softly, glaring up at him. "They're asleep!"

Poyser repeated himself, more loudly.

Ray woke up, turning his head and opening his eyes just enough to look up sleepily at Poyser. "Go away," he said distinctly and closed his eyes again.

"I will not go away!" Poyser exclaimed. "This is intolerable!"

"Yes, it is intolerable, Lieutenant," Rokey said. His voice was a low rumble. "I will not have you disturbing these people."

"Turn off that movie and get her out of your quarters!" Poyser shook Regina's ankle roughly. "Wake up, Miss Renown, at once!"

"I'm awake," Regina spoke without opening her eyes or moving. "Where am I?"

"You're with me, ma'am," Rokey answered her. He looked down at her sweep of colors curled up so trustingly beside him, the long, soft curves of her, and then he looked up to the hard white face of Lieutenant Poyser. "I told you not to disturb these people," Rokey said quietly, evenly. "Now you've waked them both up."

"I'm not awake," Ray said from amidst his pillows.

Poyser unlocked the hilt of his stingblade with slow, deliberate gestures. He drew the weapon and stepped back to raise it, but Ray proved he was not really asleep at all. At the soft sound of the stingblade being drawn, Ray's eyes flew open. Before Poyser could raise it fully to aim, Ray had leaped from the floor in a single, hard flash of anger, knocking it from Poyser's hand with both fists. Ray stopped short of striking the man a second time, instead snatching the weapon from the bed where it had fallen.

"I'll see you in jail for this!" Poyser snarled. He fell back in a half-crouch as though prepared to fight Ray. His pale white face was pink with rage.

"We're *all* in jail here together for the next two months, Lieutenant!" Ray said, cold outrage clear in his voice, "but you are *not* in charge on board this ship. I am captain of the *Yankee Shadow*, and that makes me the law around here. And until we land, the captain says *no* weapons, *no* handcuffs and all the fraternizing we need to stay sane while cooped up in here with you!"

Poyser froze in his defensive crouch, glaring, then drew himself up straight, folding his hands behind his back in formal stance. "As I am outnumbered in this situation, I have no choice but to comply, but I can assure you that this whole matter will be dealt with harshly once we arrive at Freedom."

"Write all the nasty letters you want, Poyser," Ray said, "but no weapons and no handcuffs on my ship."

Poyser drew a deep breath and shuddered. "I don't understand this, Captain Harris. Miss Renown is a criminal. I am

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simply trying to uphold the law. Why are you so determined to prevent me from doing my duty?"

"While we're in this Intraspace corridor, Poyser, we are in a closed universe," Ray said. "The laws are the laws of this ship. That means that I am in charge. Law number one on board this ship is that civilized behavior gets civilized treatment, and you haven't acted civilized once since you got on board. Does that make it any clearer?"

"Yes," Poyser said crisply, almost hissing. "Yes, most clear."

He turned in sharp, military style and marched to the door. He stopped in the entry, and looked back at Ray. "May I have my blade back, Captain Harris?"

Ray frowned. "Rokey?"

Rokey shrugged. "He's a policeman, Ray. He won't kill you unless he has to."

Ray held the stingblade out to Poyser, holding it by the guard ring. "But first I want her out of those cuffs," he told him, drawing the weapon back out of reach.

Poyser hesitated as though considering the deal. "Yes, of course," he said. He took the weapon, holstered it, and pulled the key case from his belt to hold out to Ray.

Ray did not take it, but glared at Poyser.

"And a fingertip as well?" Rokey suggested.

Poyser's distaste was clear, but he went back over to the bed. Regina held up her hands, wrists close together so that it did not show that the band had been cut. When he unlocked them and they fell free from her, Ray stepped in swiftly and caught them, immediately holding them behind his back with one hand. With the other, he took the key case from Poyser. "I'll just put these away somewhere safe so you won't be tempted in the middle of the night sometime to try them out."

"He has another pair," Regina pointed out.

"Of course he has," Ray said with a sharp grin. "And we'll just go fetch those before we get back to our movie." He gestured to the corridor.

"Yes, Captain Harris." Poyser stalked out.

Ray stashed the damaged handcuffs and the key case in the bottom drawer of Rokey's desk. "Lock that drawer," he said to Rokey as he went out.

"*Yankee Shadow*," Rokey said, pitching his voice to computer control. "Rokey says put a security lock on right bottom desk drawer. Do it."

The computer interface in his desktop rang a low note of compliance.

Regina giggled. "You can talk to your starship and make it do things?"

"Sure," Rokey said. "That's just basics. I don't use it very often. It's not very reliable, but I don't want to get up just now. Don't you talk to computers on Freedom?"

She shrugged. "Not for anything important like a security lock. It would be too easy for someone else to play back the command and use your computer."

"Only if it gets recorded," Rokey said, frowning.

"Everything on Freedom is recorded," she said as she settled back down and closed her eyes.

Poyser was standing in the entry of Ray's room with the handcuffs when Ray caught up with him. Ray frowned, feeling the rise of his distinct discomfort at having the policeman staying in his room. As he took the handcuffs, he glanced around the entry and saw the gleam of a trideo camera eye.

Ray scowled, stretched up his lean height and snapped the trideo camera off its mount. It had been aimed to monitor the corridor around the entry. He handed it Poyser. "Put that away, please."

Poyser's pale face was calm as he took the tiny spy-camera, but a strange bewilderment swept his eyes, and something in him sagged, as though Ray had cut a string that had been holding him up. He

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looked down at the damaged piece in his hand, sighed and turned inside without a word.

"Do you want to watch movies with us, Poyser?" Ray called in after him.

After a moment, Poyser returned. "Actually, Captain Harris, what I require most is food. If you would be so kind as to show me to the galley?"

"Sure, no problem," Ray said. "Right this way."

This uneasy peace held for a few days. Poyser came out of his room only for meals, as though he were the prisoner on board. He was quite formal in his every interaction with the others, and he kept his hands folded carefully behind his back whenever he encountered them. Ray stayed in the gamesroom, exercising with the machines and playing games with the computer. He was beginning to notice how much time "Mr. Rokey" and "Miss Renown" spent snuggled together cozily in the light of the trideo screen. Ray knew that Rokey was a lonely man, and he knew why. He tried to stay discreetly out of their way.

Ray's usual "morning" wake-up routine included jogging through the corridors of his ship. Even though his gamesmachine gave him a complete physical workout, the run was as much for the sake of reviewing the *Shadow*, casually checking her status top to bottom, fore and aft, as for stretching his legs. Ray was born on a starship, raised in the rituals and traditions of survival in space, and these gestures guided the way he lived. It kept his senses sharp.

Ray had very sharp senses. Poyser hid the Freedom Eyes cagily, but not cagily enough to elude Ray's sharp vision. Ray pulled the first one he noticed down from its mount and strode off to find Poyser. Ray said nothing, merely handed the little camera unit to Poyser and stalked away. His run after that lasted longer than usual. He was angry.

Once he began actively looking for them, Ray found the Eyes stashed everywhere, even in the cargo hold. He collected them with grim determination, returning them to Poyser one by one without a word.

Poyser refused to give up. Ray refused to give in. It became an elaborate shipboard game for the two of them, played out in silence.

After a week of it, however, Ray got tired of the game. He started carrying a q-wrench with him, the heaviest hand tool he could find in engineering, and simply smashed each one as he found it, leaving the pieces where they fell. Even this, however, did not discourage Poyser. He put up fewer of them, waiting until after Ray's wake-up jog. Ray was almost amused by the man's peculiar determination. Almost.

After the second week Ray had had enough.

"What is it with you and these skubbing monitors?" Ray demanded to know. "Are you just trying to make me angry so I'll start a fight with you, is that it?"

Poyser gasped as though struck. "Captain! I do not put them up either for or against *you!* I put them up for myself . . . I can't bear . . ." he turned away, his voice quivering. "You just do not understand, Captain. I cannot bear to be unmonitored. It makes me feel so lonely, as though I am being erased with every moment. I feel there is no way to prove I exist without the Freedom Eyes. I can find myself anywhere in time by scanning my own archives, but if I am not recorded, I have lost that time of my life. It is gone!"

"You got yourself one strange hobby there, Poyser," Ray said, shaking his head in surprise.

Poyser turned back and put one hand out hesitantly on Ray's sleeve. "Oh, it is not a hobby, Captain! Far from it!" There was a sudden eagerness in him, a kind of hope shining in him. "This is the way of my world, the way of Freedom! Everything on Freedom is recorded, every-

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thing we do, everywhere, all of us, alone or together. The Eyes of Freedom are everywhere! They watch us. They protect us." As he finished speaking, he glanced furtively to the side as though checking for the camera, or his audience. "They free us."

"Free you!" Ray was astonished. "How can that be freedom? They only do that to people in prisons!"

Poyser's hands fluttered with the intensity of his devotion to this belief. "There are no prisons on Freedom, Captain. We have no need of them. There is no crime on Freedom. We are free to do anything we want, live any way we want, so long as no one is hurt and none are neglected. Freedom is without violence, without corruption, without poverty."

"Sure," Ray said with a sneer. "No one dares to do anything they don't want someone else to see."

"Indeed, Captain!" Poyser said eagerly. "You do understand!"

Ray shuddered, an involuntary reaction to the thought of such a life. He scowled, lifting an eyebrow. "Then why does Freedom have policemen?"

"The need for authority figures goes far beyond the confrontation with crime," Poyser said, speaking with dignity. "My responsibilities are ordinarily more of an organizational function."

Ray laughed. "You direct traffic!"

"I have also handled street fights and such. Young people are always eager to settle their differences in public."

Ray shook his head. "What a world."

"Freedom has been a successful colony for more than five hundred years, Captain. We do not need your pity."

"Fine," Ray snapped. "And I don't need monitoring. I can find myself anytime I want to." Then his eyes narrowed. "Are you putting those things up in *my* quarters?" he demanded to know.

Poyser pulled himself up defiantly. "Yes."

Ray regarded the man for a moment with angry eyes, and then relented. "All right. But I want a computer inventory of every one you have up and its location, and I want that inventory checked when you go to make sure you don't leave any behind."

Poyser's gratitude was embarrassing. He agreed, almost laughing as he spoke. "I always keep such an inventory, Captain. That will not be a problem. Thank you."

"And you only monitor yourself—got it?"

Poyser hesitated briefly, then said, "I am required to monitor my prisoner as well, Captain."

Ray held up a finger, started to speak, thought better of his words and said instead. "Keep your Eyes to yourself, Lieutenant, or I'll show you a new way to monitor yourself—from the inside."

Ray heard the strains of Rokey's favorite homeworld orchestra starting up a familiar theme. The music swelled up to fill the ship. Ray stopped jogging and peered around the corner of the galley corridor. Rokey and Regina were taking advantage of the width and length of the main corridor to dance. Ray froze, watching in fascination.

Regina was slightly taller than Rokey, and he was a great, wide, black-furred bulk beside her lithe rainbow form. She clung to him with perfect ease, head tilted so that they were looking into each other's eyes as they danced. Her gray skirt flowed behind her as part of the music, swirling in graceful lines. The music was slow and sensual, throbbing with the complex drum rhythms that Rokey fancied, and they danced as though they had been partners for years.

Ray ducked back into the galley corridor and went into the games room to chase phantom pirates in a cyber-dimension.

Ray woke up from a nightmare about attempting to get into his quarters using a laser saw to cut through endlessly re-

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growing layers of duct tape. The noise of the saw was an eardrum-grinding, raw, throaty sound, and it roared overwhelmingly as he struggled to get to his own bed. From his room, behind the duct-tape barrier, he could hear laughter, cold and mocking.

Ray sat up abruptly, realizing that he was on the floor in Rokey's quarters, the cushioning pillows all flung out of reach. The ragged noise of the laser saw was actually Rokey's amazingly textured and loud snoring. The laughter and flickering light were from the movie playing out unobserved on the trideo screen. Ray had fallen asleep on the floor once again. Regina and Rokey were also asleep, curled up together like children in a meadow. Ray knew Rokey had not slept in days, and Ray let himself out very quietly.

The bed in the guestroom was too comfortable, bigger and more adjustable than his own, but that did not seem to help. It was a long time before he fell back to sleep. The dream of the taped-shut entryway picked up again, quieter, but just as frustrating.

"Get out, Ray," Rokey said to his partner. "I mean that in the nicest possible way, but get out of my room." His voice held no malice. His face was pleasant, but there was danger in his copper-colored eyes.

Ray understood. "I've had it myself. You two are getting on fine together, and I want back into my own bed."

Rokey grinned, whiskers curled back. "Thanks for understanding, son."

"You making love to her?" Ray asked, a roguish tilt to his eyebrows.

Rokey frowned, whiskers flat. "I don't make love to children, Ray. You know that."

"She's older than I am!"

"And you'll be a brat until the day you die!" Rokey said with a chuckle. "But you know how I feel about naked skin. Wozurn children have naked skin, and I am not turned on by children. But Regina and I are comfortable together, company. We talk. We cuddle. We dance. She helps me to sleep."

Ray saw his alien partner in a new and clearer light. He realized how much of Rokey's insomnia was an incurable loneliness. Rokey had slept next to his wife for nearly a hundred years before being forced into exile, on the run with Ray and the *Yankee Shadow*. There are some things even dreams cannot replace.

"I'll get Poyser moved into the guest quarters right away, old man," Ray said quietly. He patted Rokey's furred shoulder. "You and the lady just keep dancing."

"This is intolerable!"

"You've said that before," Rokey replied to Poyser's intrusion. "And it's still true." His voice was cold. Regina was curled up beside him, seemingly asleep, and did not stir.

"You are letting this woman's reputation destroy your morals, Mr. Rokey," Poyser spoke as if reading off a news release or a bad trideo script while standing in a spotlight.

"The only thing I know about Regina's reputation is that you don't like her," Rokey replied. He wasn't quite whispering, wasn't quite growling, but his annoyance was clear, however patiently expressed. "That's good enough for me."

Regina sat upright, drawing herself into a tight curl against the headboard of Rokey's bed. "What about my reputation?" she asked Poyser. She wrapped her arms around her knees, blinking at him sleepily.

"Well, for one thing . . ." Poyser was caught by surprise, and stuttered incoherently for a few syllables. "You've had your body artificially sculpted!" Poyser seemed to have difficulty breathing.

"Twice, actually," Regina said with a casual shrug. "No one noticed the first time because I was offworld. I'm older than most people know."

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Her blue eyes took on a dreamy, distant look, lost in memory. "That was the first time I was free of the Eyes of Freedom, the first time I belonged to myself."

"You see!" Poyser was shrill. "She admits her treason!"

"Oh, freely," Regina said, resting her head back on the headboard and closing her eyes with a sigh. "I admit everything. That's why I left."

"You ran away from justice!"

"I ran away from death," Regina snapped. Her eyes snapped open, her head upright, her chin lifted. "You were all ready to kill me because I didn't want to be stared at anymore!"

"Destroying the Eyes of Freedom is treason!" Poyser clearly believed this. His passion shone from his reddened face. "You led an entire generation to treason!"

Regina sighed with weary impatience. "A handful of misfits thought it would be fashionable to get excited and smash up some public Eyes." Her breath caught, and she fixed Poyser's hot glare with her cool disdain. "You and your kind are willing to *kill your own children* for the sake of a few snoop cameras. And you accuse *me* of treason!"

"Treason?" Rokey demanded.

"Destroying the Freedom Eyes is the first act of treason on our world," Poyser said. He had drawn back, hands folded, eyes hooded. "Miss Renown is the most popular, well-known celebrity in our entire system, our first interstellar celebrity, in fact, and when she destroyed the Freedom Eyes in her home, she set an example of treason that could destroy our society." The way he said "interstellar celebrity" made it clear he regarded that in itself as a criminal act.

Regina turned her blue eyes to Rokey. "I got fed up because every hacker, StellarNet coaster, or pop-cult fan who wanted could watch every single instant of my life. I got fed up with it. I've made over a hundred movies, good movies—yet bootlegged Freedom Eye film of me swimming in my pool outsells the entire collection." Regina had shown no bitterness for her situation before this, but it was clear that the pain of this went deep. "There's an entire Net site dedicated to watching me *sleep*. I was entitled to some privacy."

"You use that as justification for your crime?" Poyser demanded. His voice was a little too loud, too certain. "And simply because of that you destroyed the Freedom Eyes in your home?"

"Every single one I could reach," Regina replied promptly, smugly. "And bootlegged copies of those Eyes recording my hysterical attack before I smashed the last one was the biggest-selling entertainment package on the planet for three years running, bootleg or no." She fixed Poyser with those blue, solemn eyes. "Perhaps you are just annoyed that you weren't in on the profits?"

"It was treason!" Poyser exploded. "Treason and disloyalty!"

"It was exhaustion and loneliness," she said sadly. "I hadn't slept in months for the nightmares about people stacked around my house, following my every move. My stomach stopped working. My husbands left me, all three of them at once! They were tired of being called Porn Kings because every time we made love it was shown on network TV. I had a right to privacy!"

"It is true that the Freedom Eye Foundation has been presented with a particularly stiff challenge in keeping young, undisciplined computer workers from breaking into the Archives in search of private images of celebrities." Poyser paused in his lecture to glare at Ray and Rokey. "When our colony was originally established, there were no celebrities. Interstellar influences have undermined a great deal of our society, but we were doing everything we could to insure Miss Renown's privacy."

"And I did something to *guarantee* it," Regina said coldly. "I had to accept exile from my homeworld as a result. I've lost my entire life because of this."

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"Exile!" Poyser spat the word. "You ran away from justice!"

"I ran away from loneliness!" Regina's response was almost as hot as Poyser's attack, but she recovered herself more quickly, drew back, cooling her voice and hooding the rage in her blue eyes. She was an actress, a professional. She was alone, with nothing to fall back on but her profession. "I couldn't endure the Eyes anymore. I began to feel as though they were erasing me with every image they took, as though the more pictures of me they took, the less there was of me left for me." She sighed, stopping herself as a surge of darker emotion rose in her breast and her pulse. "I was getting old and I knew they would record every image of me aging, every image of me fighting that age—and every image of me losing that fight. The public already had so much of my life that there was nothing left for myself anymore. I don't owe Freedom anything anymore."

"Every citizen knows that their life is recorded into the Archives!" Poyser tried to step hard on the compassion her voice compelled.

Regina leaned forward slowly, deliberately, fixing Poyser with fury in her gaze. "And every citizen knows that as long as they commit no crimes, that archival record is inaccessible, private! I had no such privacy!"

That odd bewilderment struck Poyser's eyes. "Why do you want it? You are an actress, a celebrity. You *asked* for the world to look at you!"

"I asked the world to look at my art! My life is not my art! I am not my art!"

"Yes, you are," Rokey interrupted with a heavy sigh. "In a world so innocent still of movie mythology, art and life are too vaguely separated. You are a victim of your own success."

"And you will get justice!" Poyser declared grandly, as though he had won something. He turned with a sweeping, overdone gesture and fled.

"Justice!" Regina said bitterly. "They've tried and convicted me already. Poyser is taking me back for execution."

Rokey sat up to look at her in surprise. "Execution?"

She tilted her head in a gesture of distress. "Yes. There are no prisons on Freedom because the penalty is death, always, no matter the crime."

Rokey's shocked outrage made his copper-colored eyes darken to blood red, and his long whiskers pulled down flat to his face. "Holy Grid!" His voice was a whisper.

"I became an actress because of those Eyes," Regina said. Her voice was steady again, her face closed, but Rokey could see the shimmer of tears as she blinked. "They don't tell you that you are being watched until your fifth birthday. You're free to make mistakes until then, but you have to start learning." She smiled down at her folded hands, a careful, professional smile. "I remember the moment still so perfectly. Everything changed." She glanced up at Rokey, and her smile was suddenly gone. "You do get to look at your own life, you know, at anything the Eyes have recorded you doing. It gets complicated with anything too public, but the private stuff, the moments the Eyes record of your home life, your family life, that is yours and you can look at yourself. Everyone does."

"I don't know if I would," Rokey said stiffly.

Regina leaned across the bed and patted his knee. "Everyone does. Everyone wants to know, did I say the right thing in that argument with my lover? Did I really act unkindly at dinner?" She chuckled lightly. "Everyone's life is the most interesting story they know."

"And you wanted your life shown on a larger-than-life screen?"

"No, not really." She paused, searching memories. "I simply became obsessed with controlling the images of myself that were being recorded. I started 'acting' just as part of daily life, posing and setting up scenes, rearranging

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my room until it was a stage-setting for whatever dramatics I could come up with. I think . . ." She had to stop, to catch her breath, to calm herself. "I think I was creating an outer image that I could control because I felt so exposed when I learned about the Eyes. I had been spied on in every moment and hadn't known, and that just seemed so horrendous at the time."

"It's worse now, isn't it?"

Regina nodded. "Much worse. Now I have created an outer me that is so successful that the me I have protected all this time has been buried by her."

A long, slow shudder swept through her, as graceful as everything she did, but Rokey felt the gesture with the keen awareness of the pain behind it.

"And when we reach Freedom, she will bury me completely and for real." Regina stood abruptly and strode across the room to Rokey's desk to pick up her handbag.

"These are not copies of my work," she said solemnly as she pulled a case of crystals from the neat, elegant handbag. "These are the originals of every movie I've made. It was always in my contracts that I only license copies, that the originals belong to me." She glanced up shyly at Rokey, her eyelids fluttering as she held out the case to him. "I know what happens to artists who lose control of their own artwork." Her voice was solemn. "I never let these out of my sight. Perhaps if you add them to your collection they will be safe after I'm . . . gone."

Rokey realized his hands were shaking when he took the case. His outrage was rapidly boiling over. "They're going to kill you because you smashed up some police surveillance cameras? Is that what this is all about?"

"Yes." She was an actress. Her voice was clear, cold, and precise and almost hid the fear. "They are going to kill me for that."

The hell they are, Rokey thought to himself, but he turned to the movie console, opened the case of recording crystals and said only, "Lady's choice—which one will we watch first?"

Later, seated alone in the galley with Ray, Rokey explained what he had learned from Regina.

"I had promised myself I would not ask her what her crime was," Rokey concluded. "I didn't want to know, even though the speculation was driving me crazy. Now that I do know, it's making me even crazier." He paused, shaking his head. "And she is one nicely talented actress, too. And an even better director. She still has a lot to give to her world, to a lot of worlds."

There was a time in Rokey's career when he had the power to make an actor into a billionaire with a review like that, however casually given. Now he could only hope to save Regina's life.

"Poyser has interstellar law on his side," Ray said unhappily. "Extradition is legal. The people of Freedom Foundation have the right to make and enforce their own laws. What can we do about it? We're just hired transport." Despite his words, it was clear Ray felt the same way as Rokey.

Rokey sighed. "I didn't say it would be easy."

"I'm willing to beat the guy senseless for you so we can throw him off the ship, but I draw the line at killing him." Ray tried to sound light. "And you made me give him back his blade."

Rokey chuckled, and some of the darkness in his eyes lifted. "I'll hold him down while you get the stingblade. Then we beat him senseless and throw him overboard."

Ray pushed himself up from the galley table and picked up his cup. "We've got almost a month to figure this out before we're out of Intraspace." He shrugged. "Maybe we can talk some sense into him. Make him agree to let her go."

"*Then* we beat him senseless."

"There's more than one way to beat him at this," Ray said with a chuckle. "I

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refuse to believe I can't outsmart him."

"He hasn't got any of those snoop cameras around here, has he?" Rokey asked, suddenly alarmed that Poyser might somehow overhear them.

Ray shook his head. "I check for them every morning. He hasn't tried to put any up since we moved him out of my room."

"Keep checking," Rokey said. "Regina's dislike of being snooped is contagious."

"I would like my handcuffs returned now." Poyser interrupted them at dinner. "Those handcuffs are official police equipment, Captain Harris," he went on. "I am responsible for them."

"Gee, we're only a week away from landing, Poyser," Ray said amiably, covering the rise in tension with a quick grin. "What took you so long to ask?"

They were in the galley, having supper with Regina. It was hot soup, and although Rokey allowed meals in his room, hot soup was banned. They were, after all, in a moving vehicle. Rokey resisted the urge to throw his bowl into Poyser's white face, and just sat glaring at him.

"May I have them returned?" Poyser said, too loudly.

"Those cuffs were very dense plastic, high-quality hydrocarbons." Ray smiled.

"Indeed, Captain. All my equipment is of the highest quality. May I have them returned?"

"Can't do that." Ray spoke evenly, but he was on the verge of laughter. "You ate them."

"What?"

"I had to find some way to make supplies stretch for two unexpected passengers," Ray said calmly. "Judge Whythe got your transportation for free, after all. She didn't pay for your food, either."

Poyser glared in shocked surprise, but then his eyes narrowed sharply. "Is this some kind of stupid joke, Captain?"

"Not at all, Poyser. Those cuffs were good, solid hydrocarbons. Why waste them? This ship has very high-quality recycling equipment."

"What?" Poyser exclaimed again.

"I recycled the handcuffs, and you ate them." Ray grinned but his eyes were no longer amused. "I had to feed you something."

"I see, Captain," Poyser said tightly. "As you say, you had to feed me something." He stood blocking the entryway to the galley as though he could barricade them in. "I can reassure you, however, that this will result in legal action."

"You'll kill us, too?" Rokey said.

"You are not citizens of Freedom," Regina spoke up. "All they can do is banish you from their end of Earther Space."

"There are financial penalties as well," Poyser snapped.

"We've gone broke before, Poyser," Ray said. "Don't tempt me to try something."

"Captain," Poyser said carefully, "you have stated that civilized behavior is demanded from everyone on board this ship. Is that correct?"

Ray nodded.

"I assume then that this rule applies to yourself and Mr. Rokey as well."

"Morality begins at home." Ray almost smiled.

"And do you not consider it civilized to obey the law?"

Rokey interrupted, his voice deliberately light. "Don't try it, Lieutenant. Ray can run rings around you in any logic game. He learned the rules with real gunfire bouncing around his ears."

"And it's my ship," Ray added softly.

"Poyser," Regina broke in. "I promise to behave. Leave these gentlemen alone. If it will take the knot out of your butt, Whythe does know that you are in love with her. I thought it would be meaner *not* to tell you, but I just changed my mind." Her voice was cold, professionally cold, but there was a gleam of that dark humor in her face.

Lieutenant Poyser froze, eyes wide, staring at Regina. Even his breath was

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stopped in his throat. For long seconds he stood thus, clearly undone, overwhelmed, his secret out. "How . . . How can you know?" he spluttered finally.

"We were her guests for nearly a year, Poyser." Regina tilted her head to wink at Rokey. "She and I shared a lot of secrets together."

Poyser reached out blindly, groping around him, finally bracing himself on the edge of the entryway. "Why?" He turned his face away from them and his entire body sagged. "Why did she send me away?"

Regina laughed. "Because you are a fool, Poyser! You are that much in love with her and you don't know her any better than that? She's even more old-fashioned and honorable than *you* are! And for seven months, she had to support you, provide housing and food, *pay* for your entertainment. You know what it means for a woman to pay the support of a potential suitor—and to pay publicly! That's lower than buying children!"

"It was official business!" Poyser protested in a squeaky voice. "The government of Freedom paid!"

"As far as Whythe is concerned, she *is* the government." Regina said. "If you're going to be in love with her, you better recognize what her job means to her."

The man hung in the entry, mouth slightly open, paler than his white self if that were possible. He looked at Regina with helpless eyes, the unasked question hanging in the air between them.

Regina held the moment suspended, holding his frightened eyes with her cool disdain for a long, delicious delay before she relented. "You recorded all my conversations with Whythe with your damned Freedom Eyes. Am I to believe that you are really so honorable that you haven't listened to all that girl talk already?"

"I have looked at a single moment of her," Poyser whispered. "The moment when I knew that I loved her. That is all." He drew himself up, some light returning to his bewildered eyes. "Yes, Miss Renown. I am that honorable."

"I bet he is, too," Ray said after Poyser had left.

"They sent him out to capture the most beautiful woman in their world," Rokey said. He was smiling at Regina. "They had to find the most *honorable* man in their world to be trusted to do it."

Regina returned to her soup with a sigh.

"That explains a lot about his bad attitude," Rokey went on. "Ain't nothing more stubborn than an unrequited cop." He was chuckling. "I don't know which was crueler of you, Regina, my dear—waiting that long to tell him, or telling him at all."

"Yes," she said quietly. "But my time now is growing short. I don't want him interrupting us again, and he will be busy until we land with this—should he or shouldn't he look at the recordings to see if she says anything to give him hope."

"Did she?" Ray asked.

Regina closed her eyes and licked the end of her spoon. "Oh, yes, indeed. Lots."

"You were saying something about a plan?" Rokey suggested to Ray.

Ray sat staring, unseeing, at the galley entry where Poyser had stood. His eyes were misted in thought. He folded his arms across his chest and glanced sideways at Rokey. "Yeah. But I think I just got a better idea."

Tension on shipboard was high as they landed. Poyser was packed; his overstuffed bags stood piled up in the airlock ready to go. He paced rapidly through the corridors, nervously avoiding the others. Ray and Rokey both noticed, however, that he was wearing his stingblade with the safety strap lock open and the side flap of his uniform jacket drawn back to show the hilt plainly. Rokey thought the man's eyes looked

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a little wild, but Ray asked him how could he tell with a cop. Neither man laughed at the obvious joke. There was too much at stake.

Rokey was getting nervous himself. Ray had said nothing about a plan, about his intentions for resolving this dilemma. Rokey could tell from Ray's suppressed agitation that he did have a plan, but was not certain enough of it to talk. Rokey knew better than to ask, but he was nervous. He needed to ask. Instead he busied himself with the task of Regina's last request.

"I haven't been able to soak in a tub of hot water with bubbles in months," she told him. "I would love just one last, long soak, in the dark, with a candle and maybe some soft music before I have to go."

"Bubbles?" Rokey asked in surprise. "Why bubbles?"

"I have seen enough film of myself in bubble baths to know that I am hidden in plain sight when covered in bubbles. I can soak up to my chin, invisible, and let my mind drift away. They can't really see me, so I have a time of feeling free."

The *Yankee Shadow* was set up with a central shower stall, a ring of water-jet nozzles inside an enclosing wall of glowing plastic. Tubs of water were not usual starship fittings. Rokey had to do some fancy plumbing and electronic work to create the bubble bath Regina had wished for, but the work kept him from noticing his growing angst as they approached Freedom.

Regina was delighted with the results, and pretended not to notice Rokey's distress. "I shall soak here and float in the warmth until the last minute!" she exclaimed happily.

Rokey solemnly kissed her forehead. "Enjoy it, my dear. 'Til the last minute. I'll make certain no one disturbs you."

The world of Freedom was clear in the viewscreen, green and blue and inviting, with the wreath of white clouds that is the visible breath of life. Three moons showed from here, silvery bright in the blackness of space.

Poyser stood in the bridge entry, gloved hands folded behind his back. His uniform was immaculate, the details perfect. Only the nervous twitch in his eye gave away his awareness of defeat.

Rokey sat unmoving, barely breathing, staring sideways at Ray.

Ray had also bothered to dress formally "in uniform": his black dress suit with gloves and hat. Ray's "uniform" was more formally tailored than Poyser's and fit better. Ray did not look prepared to accept defeat.

Poyser stood straighter, holding his hands uneasily at his side, close to the handle of his stingblade. "You will radio ahead and inform the Foundation that we are arriving."

Ray Harris turned in his seat to look at Poyser. "We have a little bit of a problem with that, Lieutenant," Ray said. "It seems that one of the times that I was forced to remove your spy cameras from the bridge, I also smashed my radio satellite-link circuits." He shrugged elaborately. "I take full responsibility for that, but your placement of the cameras was most unfortunate. I am afraid we won't be able to contact anyone until we're on the ground and you go out to find a working phone."

Ray's smile was all teeth.

Rokey dared to turn in his seat and stare at Ray. Rokey knew his partner. There was a tiny twitch to the corner of Ray's mouth, and Rokey relaxed, leaning back to watch. He could scent, clearly, the lavender and spice fragrance of Regina's bubble bath.

The silence stretched out to half a minute, longer, seconds poised between life and death choices.

Poyser bowed curtly, from the waist, and clasped his hands firmly behind his back. "I see, Captain Harris. Very well. I will wait by the airlock, and you will inform me by intercom when we have landed and I may go out, as you say, to find a phone. You gentlemen will, of

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course, remain here until I return with an armed escort for my prisoner."

"Not a problem," Ray said, grinning sharply.

Poyser stood a moment longer, looking at Ray, and then said, "Thank you, Captain Harris." He swept away down the stairwell to the airlock below.

Ray turned on the ship's security camera to the airlock and watched Poyser pacing back and forth along the corridor. It was only then that Ray realized that his hands were shaking, and that the residue of the panic of that moment was making his blood pound in his veins.

Rokey finally spoke up, feeling breathless himself at the impact of this good news. "Nice work, son," he said very quietly. "I assume we are lifting off as soon as he's out the door?"

"Keep the motors running," Ray said quietly. "We'll let him get safely clear." He touched the airlock controls and watched as Poyser snatched up his luggage, tapping his stingblade hilt impatiently as he stood waiting for the outer hatch to open. The shoulder-mounted security camera on his shoulder swiveled back and forth like the head of an angry cat perched there.

Rokey laughed. "He knew!" he exclaimed to Ray. "Poyser knew what you were doing, and he's just going to take his stuff and let you do it!"

Ray's face was surprisingly gentle. "He needs an excuse to go out on another extradition hunt, doesn't he? To find his way back to Judge Whythe?"

"Thanks, son," Rokey said, looking Ray in the eye.

"You go ask the lady where she wants us to take her," Ray said. "I'll get us out of here."

Rokey unbuckled and hurried out.

Ray pulled up the ramp when Poyser was clear, put the engines back online and lifted away immediately.

"There's still one problem," Ray said with a sigh when Rokey returned and they were safely away in Intraspace.

"What's that?"

"I'm out of chewing gum again." □

(Editor's Note: Earlier tales of Ray and Rokey include "The Flavor of Fire" September 1998, "Backfire" January 1999, and "That Sleeper in the Heart" October 1999.)

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BIOLOG Jay Kay Klein

A few days sooner, Ramona Louise Wheeler would have been born aboard the *RMS Queen Mary*. Her dad was a career soldier coming back to the USA with his war bride. She had been private secretary to the Nazi *Gauleiter* of Austria, and was the granddaughter of a private huntsman for Kaiser Wilhelm. Living on army bases, Ramona and Mom became thoroughly Americanized. Mom attended a Martin Luther King rally so she could meet him and got to shake his hand. Ramona got to be a roadie with a rock band just after high school. You'd expect the millennium would come before a roadie and a rocker would celebrate thirty years of marriage. Well, Ramona and the band founder Scoot Wheeler are heading straight for 2001. Her dad-in-law was a major innovator and founder of the semiconductor industry. Living in the future he helped shape, he gave Ramona a perspective on the nonstoppable segué of the present into the future.

When dad left, Ramona and mom stayed behind in South Carolina, in a house bordering on a thousand acres of heat-sodden swamp. Ramona learned her best hangouts were a couple of air-conditioned libraries. Like all future writers of SF, she ran through shelfloads of books, learning something about nearly everything. Heinlein, Bester, Norton, Van Vogt, and Cordwainer Smith along with the entire pantheon of SF writers helped with her education. Isaac Asimov was the first SF writer she met. He was a friend of a nearby Massachusetts private-school science teacher, where she attended on a scholarship.

Photo by Sherry Briggs

Ramona Louise Wheeler

She arrived at the Cambridge School of Weston in a wonderful snowstorm, feeling like an escapee of the old South, reaching freedom in the blessed North. She knew the people there would teach her how to write SF. The school added culture and civilized behavior to her education. Unread SF now being harder to find, she turned to outright science, starting with a book by Gamow, followed by Feynman and Hoyle.

Major works of SF became her writing exemplars: *Dune, Stranger in a Strange Land,* and *Stand on Zanzibar.* Well-written general literature added further influences. After graduation, helping the band by day with advertising and publicity, at nights in motels she studied physics, molecular-biochemistry, genet-

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Analog Science Fiction and Fact and David Brin are proud to announce:

WEBS OF WONDER

a new contest for teachers, web designers, and folks who love science fiction.

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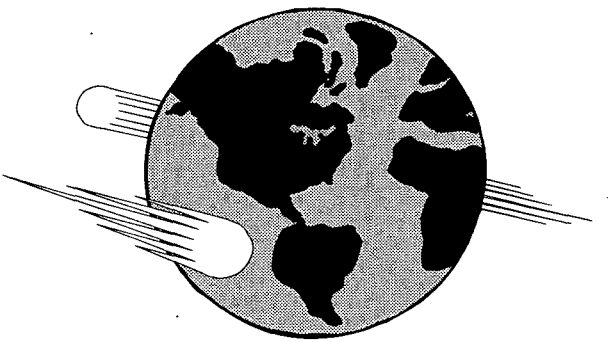

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AETHER ONE OR THE OTHER

Let's get one thing straight right at the start—the Michelson-Morley experiment did not prove the nonexistence of the aether ("aether" being the older spelling, of course, but I prefer it to "ether").

You've all heard that it did, but if you need to brush up, here's the usual story. You can find something like this in almost any popular book on relativity theory.

The Michelson-Morley experiment consisted of an interferometer mounted on a turntable. An interferometer splits a light beam shone into it into two parts and sends those parts off on different paths (usually at 90 degrees to each other). It then recombines those beams after they've bounced off mirrors and made their way back to the half-silvered splitter mirror that separated them in the first place. By allowing the beams to interfere with each other, you can produce what are called interference fringes. What these fringes look like can be the result of something or other that's different along one light path from the other one. This usually tells you something. (Interferometers are used for many things. I used one myself to determine the speed of light through various gases, and, just the other day, to witness a very small deflection of a suspended dielectric in a really fascinating experiment.)

Michelson and Morley were attempting to determine the speed of the Earth against the presumably different speed of the background aether. Theirs became the most famous null experiment in history when the expected changes in the interference fringes failed to appear. Since scientists in the 1800s weren't about to give up the notion of the Earth revolving around the Sun, the aether had to go. Einstein figured out relativity theory in short order thereafter. Now everyone knows there is no aether and all there is in space is vacuum.

Well, vacuum made up of some kind of space-time foam in constant motion resulting in the zero-point energy field, or something like that.

I know—I'm bracing for it already—the inevitable manila envelope from the editorial offices of *Analog* with fifteen letters correcting me and giving the real explanation of what space-time foam is and why it isn't really an aether, and how the zero-point energy is such-and-so, etc. I always find those packages amusing because out of those fifteen letters I'll probably find about ten different explanations about what it is that scientists *really* mean when they talk about. . . .

It's nice that there's such a diversity of opinion about ***known*** science.

Time for me to come clean. I've become an aether believer. I hadn't intended to. It wasn't something I went looking for. But inevitably, aether theories began to make so much more sense than the current views.

Theories?

Yes, plural. There are lots of different aether theories. At best, you might say that the Michelson-Morely experiment disproved the existence of an absolute,

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non-moving, mechanical aether, though even that isn't clear. It's been shown many times now that the Michelson-Morley experiment was inherently null in design. That is, it couldn't have given any kind of result other than a null one even if there was an aether, so it told us nothing. But that's OK since it's also been said that Einstein wasn't thinking about that experiment anyway when he came up with special relativity (which, by the way, had quite a pre-Einstein history of its own). And this is good because, as it turns out, Einstein also believed in an aether. As he said to his audience in Leyden: "As to the part the new ether is to play in the physics of the future we are not yet clear. We know that it determines the metrical relations in the space-time continuum . . . but we do not know whether it has an essential share in the structure of the elementary particles. . . . It would be a great advance if we could succeed in comprehending the gravitational field and the electromagnetic field together as one unified conformation." (This is quoted by Bryce DeWitt on page 681 in "Quantum Gravity: the new synthesis," which is chapter 14 in *General Relativity: An Einstein Centenary Survey,* edited by Hawking and Israel.)

What kinds of aethers are there? One I've mentioned before is the absolutely fixed mechanical one. This aether could be thought of as some kind of elastic solid in terms of the equations it obeys; and yes, it's hard to imagine how light propagating through a medium like this could maintain a constant velocity with respect to the Earth if the Earth was moving through it.

Other varieties of aethers are based on the fluid model. You can adjust parameters such as viscosity, compressibility, and the like and try to come up with a model that matches experiment. One important idea readily apparent from the fluid models of the aether is the notion of *convection*. Convective flow is simply motion of the aether through itself. One way this model explains the null result for the Michelson-Morley experiment is to point out that the aether close to the surface of the Earth moves along with it. Hence, locally, there was no difference in the speed of light along the different paths of the interferometer because the aether was at rest with respect to the experiment.

There is only one Physics, so if the Universe can best be modeled along some kind of aethereal lines, only one kind of aether theory can be the right one. I'm pretty partial to the perfect fluid models of the aether, and of those, the ones that model matter as being not *in* the aether, but *of* the aether (that's what Einstein's talking about above when he says "an essential share in the structure of the elementary particles. . . .").

This also is a very old idea. There were many attempts in the 1800s to model "atoms" as some kind of vortices in the aether, but the majority of the theorists could never get the mathematics of these models to work out consistently and they eventually gave up. That's too bad—they were so close. But one problem was with the mathematics of the aether itself.

You can go to almost any book about hydrodynamics and find out about velocity fields and flow and streamlines and all that. Usually these books start with some kind of idealized fluid to get the math sorted out, so right there you have an aether theory. Almost everyone knows that Maxwell's equations also were formulated during the era of aether theories, so it should come as no surprise that the formulas of electrodynamics and the formulas of perfect fluid hydrodynamics are identical. Indeed, one finds right in Sir Horace Lamb's book *Hydrodynamics*: "There is an exact correspondence between the analytical relations above developed and certain formulae in Electro-magnetism. . . . Hence, the vortex-filaments correspond to electric circuits, the strengths of the vortices to the strengths of the currents

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in these circuits, sources and sinks to positive and negative poles, and, finally, fluid velocity to magnetic force." (*Hydrodynamics*, Sir Horace Lamb, page 210. First published in 1879.)

Now, I want to stay close to the "problems with the math" aspect here, and the best quote for that can be found in Sommerfeld's *Mechanics of Deformable Bodies*. While discussing these same equations he says, "The nonlinearity which is caused by the presence of the convective terms makes the integration *incomparably* [emphasis mine] more difficult." (Incidentally, on page 153 of the same book, Sommerfeld also makes mention of the "perfect analogy between hydrodynamics and electrodynamics.")

What makes things so incomparably more difficult is the nature of those convective derivatives. Since these are nonlinear, superposition goes out the window, and now we're talking lots of computational power to get things sorted out and to find solutions to the equations. Such computing power was not available in the late 1800s. Even familiar hydrodynamics equations like Bernoulli's are just simplifications from the real situation to make the math not just easier, but even doable. Much of the working man's hydrodynamics is a linearized form of the true nonlinear situation, but fortunately, we can do a lot of good even with something less than the truth.

Einstein also once said that quantum theory would "be superseded someday by a nonlinear deterministic theory built, perhaps, on the lines of General Relativity itself." (A. Einstein, *Mein Weltbild*, pub. Querido Verlag (Amsterdam), 1933.) Indeed, general relativity is a nonlinear theory, and much of the math looks like that same stuff one can find in the hydrodynamics books. Aether theorists would be right at home with it.

Curiouser and curiouser.

Take a step back to the Lamb quote and consider what he said, then consider this quote from Feynman where he says: "So vortex lines are like lines of **B** [that is, magnetic field lines]—they never start or stop, and will tend to go in closed loops." And also: "The vortex lines *move with the fluid* [emphasis in original]." (The Feynman Lectures, volume II, pp. 40-10 & 40-11.) Ah, but moving field lines are a convective property of the flow, implying nonlinearity, and yet, electrodynamics is a *linear* theory.

Perhaps it shouldn't be.

Let's take a step into ordinary physics again and consider a little something called pair production. Take an electron and a positron and put them together and out comes an electromagnetic wave. Reverse the process, and you can put in the wave and out come a pair of particles. Doesn't it seem like maybe waves and particles should have a rather intimate connection (besides this wave-particle duality stuff we've all heard about)? Yet by and large particle theorists stick to their domain, and electrodynamicists to theirs, apart from the latter dealing with electrons as charge carriers.

But, of course, electrons have a property called "spin," and this is related to their angular momentum. Most quantum theory professors will tell you the spin of the electron (or any other particle) is nothing at all like the kind of spin we think of in ordinary mechanics, like with tops, or in hydrodynamics, like with vortices. That's what Wolfgang Pauli said. Actually, that's what Pauli used to think. In Tomonaga's book *The Story of Spin* (you've heard of Tomonaga—he shared the Nobel Prize with Feynman and Schwinger for quantum electrodynamics) we read this about Pauli: "Goudsmit says that soon after Thomas' paper was out, he received a postcard from Pauli saying, 'I now believe in the idea of the self-rotating electron.'"

Sorry for peppering you readers with quotes from famous physicists, but I wanted you to see that ideas supportive

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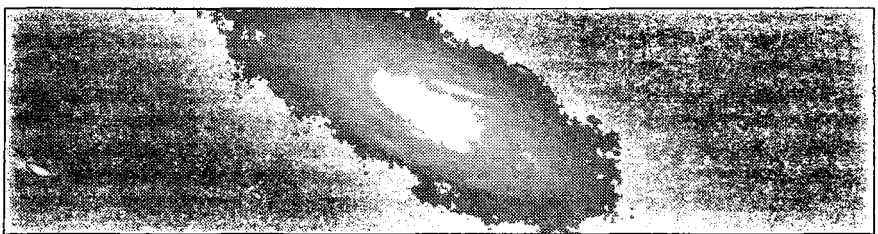
of aether theories are not held only by the heretics. To recap a bit, I pointed out that the Michelson-Morley experiment didn't disprove the aether, and that Einstein was comfortable with aether theories. I described perfect fluid aether models, with particles being a sort of "structured aether" as opposed to bits of matter floating around within an aether. I discussed how the mathematics of perfect fluid aethers matches the mathematics of electrodynamics, except that modern electrodynamics is a linear theory and the perfect fluid aether models are nonlinear, and thus, it's hard to do the math in them. I suggested that this might be where the problem lies for electrodynamics (which, as Feynman says, isn't even self-consistent) particularly as it applies to pair production. I also mentioned that even Wolfgang Pauli had come to believe that the property of spin was due to some kind of real rotation mechanism.

I think that if we just do the math, we can nicely link together *all* the experimental phenomena via an aether model that we are today trying to unify with Theories of Everything.

There is, of course, so much more, but this column is at its length limit. If you're unhappy with aether ideas, well, you can always take the foam over the fluid. But I wouldn't even do that with a glass of beer.□



Star Spears

by Ruth Berman

When you shift into time-space
You lose a dimension,
As it might be, sideways.
You can still look up and down, or ahead and behind,
But to your left the future is lined out
And to your right the past.
Stars stretch into time like spears
Shafting the length of the universe,
Joined in a knot of light where time began,
And piercing out toward shadow.

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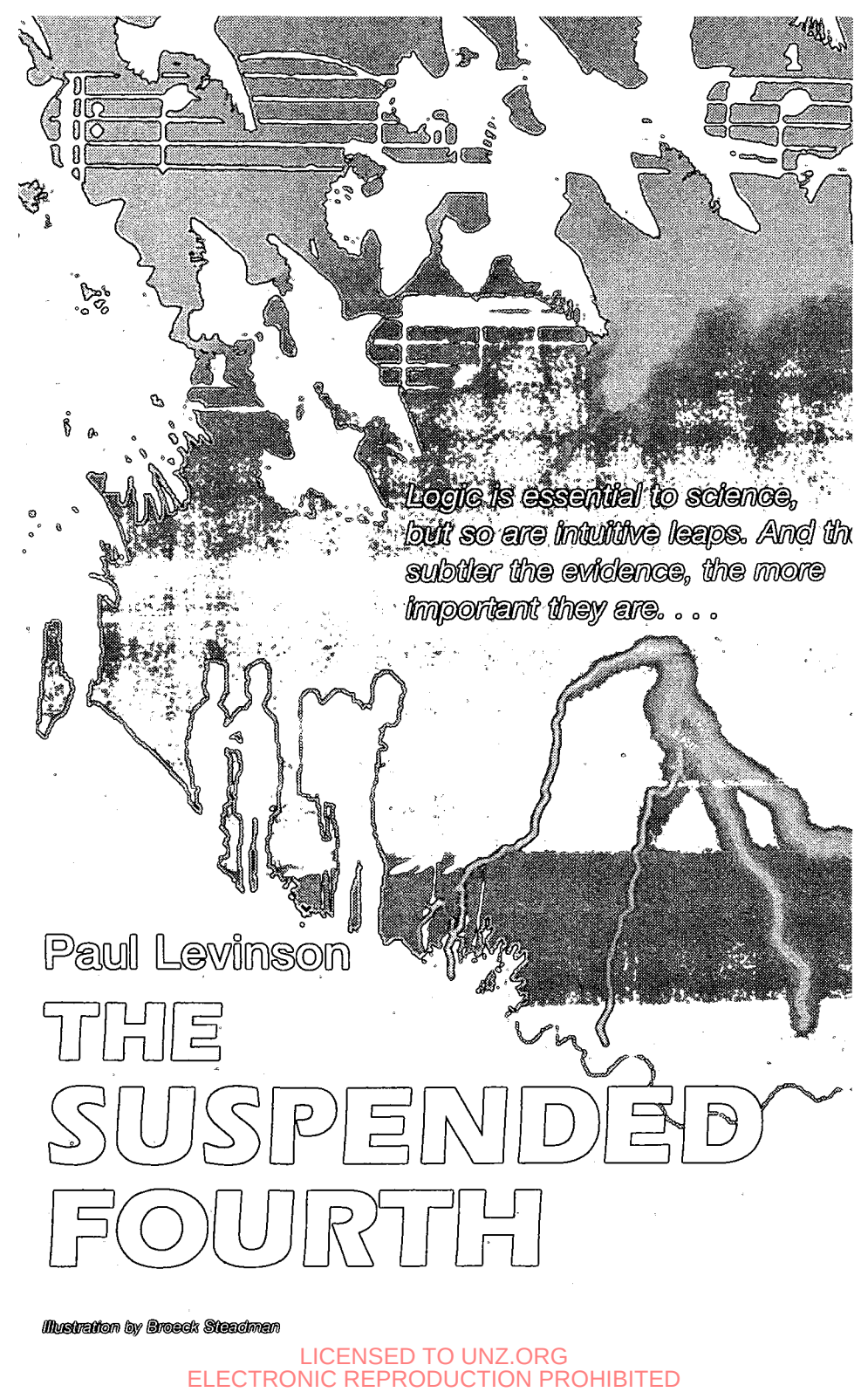

Paul Levinson

THE SUSPENDED FOURTH

Illustration by Broeck Steadman

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The second planet around the G5 star in the Peacock was near Earth in more ways than one. Only nineteen light-years from Sol, it was little more than two months away by the faster-than-light star drives of the mid-twenty-second century. Its climate was a tad cooler than raw Earth's, but it sloshed with frothy seas and an atmosphere breathable by humans. It sported half-a-dozen land masses of varying size, all tied together in a biosphere comprised of everything from viruses to mammals that looked like viverrines, from insects that glided like butterflies to hot-blooded, feathered creatures that flew like birds. Lots more of those, especially, than on Earth. But not so much as a primate, let alone anything with humanlike intelligence.

This was a planet, then, like Earth in many ways—but not like Earth in at least one way, the way that had become an obsession to the human species as it combed the stars for someone to talk to, someone other than humans . . .

Twice the science teams had come, holding back the tourists and the settlers, pleading with governments and corporations back home to stay away a little longer, lest they trample some delicate intelligence hiding in the woods or seas—or destroy some fragile technology, a clue or a sign, that an intelligence might have managed to leave behind. But the science teams found nothing. Not in their extensive DNA sampling and genome mapping of organisms, not in their sifting and staring at the stuff of this planet until even the scanning equipment was bleary-eyed.

Nothing except a lot of fine feathers, a lot of fine birds who chirped in captivating triads, major and minor, and the occasional suspended fourth . . .

The first settlement group arrived an Earth year later.

"I love it," Yevgenia Prima said to her husband, Jack Swirl, as they took in the lush green foliage that worked its way down to the sea at what would be the edge of their property. "It looks just like California, no?"

Jack smiled. "More like Cape Cod than California," he said. "You've got California on the brain because of all that Mamas and Papas music you've been listening to."

"This place seems to like that music," Yevgenia replied. "I heard something that sounded just like it in the trees, only yesterday—"

She was cut off in midsentence by a bolt of lightning that made Jack cry out in shock, and killed her on the spot.

A science team was back ten weeks later. Jack pleaded with the leader to let him stay. She was adamant that he could not.

"I'm sorry, Mr. Swirl. Death at this point—for any reason, even a lightning bolt from the sky—means the settlers must leave. Could be a symptom of some larger problem," Jenny Teng tried to explain.

"Could even be a sign of some intelligence acting to protect itself or this planet from our alien colonization," Ralph Giorgio, her second in command, added.

"You mean like on Orchard World?" Jack pressed. "Where the fruit trees were given a means of self-defense by their planters, whoever they were? I know all about that—Yevgenia's cousin was on the team that made that discovery. It was one of the things that inspired her . . ." His voice choked.

Jenny put an understanding hand on his shoulder. "It's hard to lose someone you love, I know."

"She was killed by a lightning bolt, for God's sake!" Jack pulled away. "You people think what? Some invisible intelligence that controls the weather on this planet hurled it down like Zeus?"

"That's what we're here to find out, Mr. Swirl," Jenny replied.

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* * *

Jenny and Ralph were exo-climatologists—logical choices, since the proximate agent of death was a lightning bolt. The rest of the six-person team consisted of the standard exos—botanist, zoologist, archaeologist, technologist—found on every science team.

Jenny and Ralph spent six months hanging out near extinct volcanos, mapping cloud formations, keeping careful track of every thunderstorm, every raindrop, every bit of bad or unusual weather they or their equipment could find. They found nothing out of the ordinary.

"Yevgenia's death was just bad luck—happenstance," Jenny said, as she finished her report. It would be relayed by tachyon spin to the proper authorities. Its conclusions would reopen the planet for settlement, once and for all.

Ralph shrugged. "Sometimes life is like that. Not everything has a reason."

"Jack Swirl's not going to like it."

"He was the one who said how ridiculous it was to suppose that his wife was killed by some alien intelligence," Ralph said. "Our conclusion should satisfy him on that score."

"He thought it was preposterous to think that his wife was murdered by a bolt from on high, yes," Jenny replied. "But he'll want to find some meaning, some larger purpose, in her death. He won't be satisfied in the least."

He was not.

Jack Swirl returned to the planet—now named Peacock Planet, even though it had no peacocks, just a lot of other pretty birds—to take up permanent, brooding residence.

He ran into Jenny two Earth years later. By this time, more than 1,500 settlers had happily put down roots on four of the continents. None had died of old age—or anything else—as yet. Forty-three children had been born.

"What are you doing here?" Jack asked, grumpily.

"Same thing as you," Jenny replied. "Helping out on this construction project. This continent has my favorite views."

"I'm just passing through. You got tired of the science team?"

Jenny nodded. "I needed some time off. Eight years straight on science, with no result, was enough for me—at least for now. It's no fun coming up empty-handed."

"Who told you life's supposed to be fun?"

She ignored the jibe. "We may have to get resigned to the fact that there is no intelligence out here, other than us. Even on Orchard World—the intelligence of the planters is just hypothesis. No one's actually seen any alien intelligent being as yet."

Jack looked off into the distance. "So why did you come back here? Peacock has even fewer traces of possible intelligence than Orchard. As in, we apparently have none."

"I love the music," Jenny replied.

"The birds?"

"Yes," she said. "They're so soothing. It's like having a musical accompaniment just about everywhere you go. Hear that?"

A sweet arpeggio madrigal emanated in the distance.

"Yevgenia taught rock 'n' roll in grad school back on Earth. She loved the music too," Jack said.

"But not you?"

"I used to," Jack said. "Now . . ."

"I understand," Jenny said. "How about you help me with this porch?"

The porch work was actually a planting of a genetically tailored white birch sapling, which would grow in three months into a beautifully wide wooden porch.

Jack shook his head no. "Sorry. I've got my own work to do."

A terra-molding bull-droid crashed on the site three weeks later. Five people were crushed; one died. Jenny was

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about twenty feet away—she was unhurt, but very shaken.

Jack came back to see her, as soon as he heard.

"Do you remember what the birds were singing, the night before?" he asked.

"What? What do the birds have to do with this?"

"I'm not sure," Jack replied.

"They were chirping something that sounded deep-classic, I think—maybe Bach-like, I'm don't know. You know Bach?" Jenny asked.

"Of course I know Bach," Jack said. "That seems to be pretty common on this landmass. You heard nothing unusual—nothing discordant?"

"The unusual thing is that the damned bull-droid crashed!"

"Not really," Jack said. "You said so yourself: accidents happen. Circuits aren't perfect, you know that. Every once in a while, they malfunction. There's no particular astonishment in that. The deaths on this planet are still well below the acceptable statistical level . . ." He winced, involuntarily.

Jenny softened. "So what are you hoping to find here?"

"Explanation, understanding," Jack said. "Not in the deaths themselves. But . . ."

"In the birds?" Jenny asked.

"Yeah. Maybe. It's just a feeling . . ."

"Tell you what—I know a splendid ornithologist—"

"Forget it," Jack said. "I've already interviewed six of them—Peacock's flapping with them, no surprise. They've been no help at all."

"You don't know Dinesh Rapadia," Jenny said. "He just got here last month. He's not only an exo-birdman, but an accomplished digi-musician."

Dinesh's patio opened onto a field of wildflowers, velvet and violet. He offered his guests apple iced tea—pressed from a variety of apple that came with caffeine. "This comes from Mother Earth herself," he said, "and no one knows who created it. The old girl still has some surprises."

Jenny and Jack nodded, and sipped appreciatively.

"What was your profession, if you don't my asking, before you came here?" Dinesh asked Jack.

"Journalism," Jack replied. "An old family tradition. But I'd had enough of it. I met Yevgenia, we fell in love, we decided to come here and live like people used to . . ."

"Ah, yes," Dinesh replied. "So, you have no scientific experience in the study of birds?"

"Right, I have none," Jack began, defensively, "but that doesn't mean—"

"It's all right," Dinesh interrupted with a placating hand. "This means I take your point of view *more* seriously, not less. McLuhan said people inside a field are numb to its environment—they see everything too often. But people outside—they have the keener eye for something in the environment that may be significant, but was too obvious for the experts to notice . . . . You know McLuhan's work?"

"No," Jack said, and looked at Jenny.

She shook her head no.

"Not to worry," Dinesh said. "Few people do these days. He was a philosopher who lived in the twentieth century—he said, a fish is the last creature you should ask for the complete story of water, because the fish lives totally in the water, and thus knows nothing of the impact of the shore upon the water, you see. Anyway . . . you, Jack Swirl, are a man who might have fresh ideas about birds, precisely because you are not someone who has been totally immersed in that field. So . . . tell me what you know."

Jack told him about the last moments of Yevgenia's life, and the conversation they had had about the Mamas and the Papas and the birds—

"The Mamas and the Papas?" Dinesh asked.

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"Yes," Jack replied. "They were a rock 'n' roll singing group in the twentieth century—"

"Oh, yes, I know who they are," Dinesh said. "They were part of the 'flower generation' . . . about half a century before the synthetic age in music, when everything became digital, even the generation of voices. . . ."

Jack nodded. "That's why Yevgenia loved them so."

"I share her taste," Dinesh said. "There's something authentic about those last analog recordings that have come down to us, real voices singing out to us from the past. . . . But tell me, what was it in the bird-songs of Peacock that you think reminded Yevgenia of the Mamas and Papas?"

"I'm not sure. . . ."

"Well, let's put it this way, then," Dinesh continued. "What is the most distinguishing feature of the Mamas and Papas' singing—a characteristic that someone could hear in the birdsong, and say: Ah! That recalls the Mamas and Papas for me?"

"You asked me if I heard anything discordant," Jenny offered.

"Yes," Jack said. "It's a theory I have. I've listened over and over again to every Mamas and Papas' song I could find, and there's a chord that's prominent in most of them. And . . . to me, that sound seems fraught with danger. It's a kind of clashing sound, one that makes you sit up and take notice. I think Yevgenia heard something like that from the birds here, the day before she died. . . ."

"Let's see if we can specifically identify that sound in the Mamas and Papas," Dinesh said, "so we can know just what we're listening for in the birds. One moment, please. Let me get my library." Dinesh stood up, then walked quickly into his dwelling.

"I told you he was good," Jenny said.

"We'll see," Jack replied.

Dinesh returned with a palm-sized device. "The speakers aren't the greatest on this, but they should serve our purposes. This has recordings going back to the beginning of the twentieth century."

Jack nodded.

"Mamas and Papas, mid-twentieth century, list of recordings, please," Dinesh instructed his device.

"'California Dreamin'' . . . 'Monday, Monday' . . ." the device began—

"Thank you," Dinesh replied. The listing stopped.

"Shall we listen to the first—'California Dreamin''?" he asked Jack.

"Yes. That was Yevgenia's favorite."

"And please identify for me the chord that you have in mind—the one that breathes impending peril," Dinesh said.

He instructed the device to play "California Dreamin'. . . ."

"There!" Jack said. "That's it!"

Dinesh froze the recording. The word "day" hung in the air, at the end of the first verse. . . .

"Hmmm . . . yes," Dinesh said. "A suspended fourth. An unsettled chord—with the third moved out of its place to the fourth. It does give the feeling of waiting for the other shoe to drop—a transitional moment that hangs in the balance, a conduit to something else."

"So you think the birds on this planet sing a suspended fourth when they sense a lightning storm in the works?" Jenny asked.

"I think the birds here sing a suspended fourth when they sense a death in the works," Jack replied.

"But I didn't hear anything like it before the bull-droid crash," Jenny insisted.

"So maybe you're tone-deaf," Jack said.

"Funny," Jenny said. "But if I can recognize the suspended fourth in this recording, I can recognize it in the wild."

"Let's put this to the test," Dinesh said. "We can do it scientifically. We have two competing hypotheses. One—the far more plausible at this point, I must say—is that birds on this planet are attuned to emerging weather patterns.

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Birds are like that on Earth. Except here, they sing a suspended fourth—to warn their relatives about thunderstorms. Two—Jack's theory—is that the suspended fourth is somehow a warning about impending death."

"We have no way to test the second hypothesis," Jenny said, "other than waiting around for another fatality."

"So we test the first," Dinesh said. "If it proves out, we'll have our answer."

In the evenings and weekends of the next six months, Dinesh, Jenny, and Jack separately recorded 228 sets of birdsongs from a total of twenty-two different species; seven songs were succeeded within twenty-four hours by thunderstorms with lightning; not a single one of those seven had a suspended fourth.

The three reconvened.

"Maybe we didn't get the right birds," Jenny suggested.

"Always a possibility," Dinesh said. "But at this point, we have to consider that thunderstorms per se have no connection to the suspended fourths."

"My point in the first place," Jack said, glumly.

"So what do we do now?" Jenny asked.

"We examine the second hypothesis," Dinesh said. "We wait for death."

Jack got the call, three months later, on the northernmost landmass, Feather.

"I'm down here on Beak," Jenny said, slightly out of breath. "A woman, about thirty, apparently died in her sleep last night."

"I'll be right down," Jack replied.

Dinesh joined them. "It still happens," he said. "Death by natural causes at those ages. From what I was able to learn, she apparently had a history of it in her family—aneurysms in the brain. She must have known someone in Records back on Earth—they never would have cleared her for settleship, otherwise."

"Are they going to investigate?" Jenny asked.

"Nah, no real reason to," Dinesh replied. "With 4,000 settlers here now, and 200 some-odd births, three deaths is still way under the alarm level."

"Good," Jenny said.

"But we'll conduct our own little investigation, of a different kind," Dinesh said. He pulled several little sound devices out of his pocket, and gave one each to Jenny and Jack. "Listen to this." Dinesh's fingertip touched a colored oval on his device. A one-minute collage of suspended fourths—of various amplitudes, frequencies, and durations, some in chords all at once, some spelled out in arpeggios—ensued. "So," Dinesh said. "Now we conduct our interviews."

They each interviewed ten different people from the area, randomly chosen from the population.

Jack approached a blonde, about twenty, as she was about to take her lunch break.

"Excuse me, Nancy Keyes? I'm Jack Swirl—"

"Nice name." She smiled.

"Thank you. I wonder if you could spare a few minutes, and help me with a survey I'm conducting—"

"I have very normal preferences," Nancy said.

"Well, this is about the birds."

"OK." She smiled again.

"I'd like you to listen to this, and tell me if you think you heard anything like it last night." Jack touched the oval, which called forth the one-minute collage.

Nancy shook her head slowly. "You mean, did the birds sing like that last night?"

"Yes," Jack said.

"No," Nancy replied. "The birds I heard were much sweeter. With a kind of underlying refresho-beat."

"You sure?"

"Well, I guess sweetness is in the ears of the beholder. You want to come by my place tonight and listen?"

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* * *

Jack had dinner instead with Jenny and Dinesh.

Their surveys produced the same results.

Two of the thirty subjects refused to answer any questions. Of the remaining twenty-eight, not a single one recalled hearing anything that sounded like a suspended fourth from the birds of Peacock—*not the night before, not at any time.*

Jack sighed. "It still doesn't mean I'm wrong—it just means we don't have the evidence."

"Jack, there comes a time when . . ." Jenny began, then thought the better of it.

"Surely the birds aren't prescient," Dinesh said, putting a local mushroom, thoroughly tested and sautéed, in his mouth. "A woman in apparently perfect health dies in her sleep of an aneurysm, how on Earth—or on Peacock—could birds, anyone, possibly know that the night before?"

"The birds would have to be incredibly careful observers of the human condition," Jenny mused. "They would have to have recognized something in the woman's expression, demeanor, that alerted them that she was about to die that way. All but impossible, considering that our species arrived here such a short time ago."

"Right," Dinesh said. "Even if we start with the assumption that the birds are somehow observing events on this planet, and trying to sound some kind of warning with that suspended fourth, for them this death could not be much more than a random occurrence—unpredictable. So the absence of a suspended fourth in the instance of this woman dying disproves nothing . . ." He fiddled with his knife. . . .

Then he suddenly lunged at Jack's face—

Jenny shrieked. "Dinesh!"

Jack's reflexes were quick. His hands were around Dinesh's wrist. The knife dropped to the cobblestone of the outdoor terrace.

"OK, OK," Dinesh said, and pulled his hand free. "I've made my point. My apologies."

Jack glared.

"For God's sake, what point?" Jenny asked.

"No one could have predicted, last night, or even a few minutes ago, that I would jab at Jack like that," Dinesh said. "So, in that regard, this episode is just like the woman dying."

"So—?" Jenny began.

"But what I just did goes beyond someone dying unexpectedly in her sleep," Dinesh continued. "It shows much more convincingly that the birds are not connected to death."

"But you didn't kill me, didn't even hurt me, had no intention of doing either, so this has no relevance to the birds," Jack said.

"Yes, it does," Dinesh said. "Think about it: how could the birds have known the result of my action once it started? Look at how shocked both of you were. Why didn't the birds blare out a suspended fourth as soon as I made up my mind and tensed my muscles to come at you? Or even at the moment my arm went out? Listen . . ." Dinesh put his index finger to his mouth. "Hear anything different?"

The same distant, soft variation on a serenade that they had been hearing all evening was all they heard now.

"I'm sorry," Dinesh said to Jack. "But I think the birds are no harbingers of death, or even danger—what just happened at our table proves it. And we've already proven that they have no connection to lightning."

"What about a connection to lightning that causes death?" Jenny asked, looking at Jack, desperate now to give him some thread to hold on to.

Dinesh shrugged in frustration. "How could we ever demonstrate that? It's such a rare occurrence. The first science teams made extensive recordings of the

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birdsongs on this planet. I had them scanned for suspended fourths—there were only three of them, from the three most common species, in more than 500 hours of recordings. And none presaged lightning storms, or deaths—"

"Deaths as they recorded it," Jack objected. "Our science teams couldn't possibly have tracked the death of every organism in their vicinity, or even every potentially dangerous weather pattern."

"That may be so, but you can't support a hypothesis with unknown evidence," Dinesh said. "Our working theory would be, what? That the birds sound a warning when they see events—weather conditions, special kinds of storms in the making—that they know will cause death, have caused death in the past? Except we have no evidence that suspended fourths have anything to do with even bad weather on this planet, let alone death." He shook his head. "No. We would have to wait for another deadly thunderstorm, and who knows when that will happen."

"How about volcanos, earthquakes, fires—there are other causes of death," Jenny said.

"You won't find them on Peacock in volcanos and earthquakes," Dinesh said. "You know that. This planet is remarkably stable in those areas. As for fires—well, sure, that could happen. But my guess would be that, even with a deadly fire, we won't hear the suspended fourth. Jack, we may have to face the possibility that what Yevgenia heard was just coincidence. For all we know, it may be years or more before anyone hears a suspended fourth again from the birds here."

He was concerned enough about Jack's feelings not to say that it was also entirely possible that Yevgenia had not heard the suspended fourth in the first place.

But Jack knew that was what Dinesh was thinking.

Jack got up from the table, and took one look at Jenny.

"Thank you," he said, softly, and left.

His phone rang almost fifteen months later, to the day.

"Jack—"

"Jenny—how are you?"

"I spoke to two people who heard it," she said.

He knew, instantly, what she was saying.

"When?" His mouth was dry.

"Late last night," Jenny replied.

"You're not just saying this to make me feel good?" But he knew Jenny would not do that.

"No. I just finished the interviews—the two folks I spoke to were sure. I've been quietly distributing Dinesh's one-minute collage all year, figuring it couldn't hurt, and I got the call last night. Apparently lots of people here heard something a little after nine in the evening that sounded like a suspended fourth. I flew in first thing this morning with my own little player and confirmed it."

"Are you OK?" It suddenly came over Jack that, if his wild theories were correct, she could be in trouble.

"I'm all right. The sky is clear, it's a beautiful day."

Just like the day that Yevgenia died.

"Where are you, exactly?" Jack asked.

Jenny told him.

"I'll be there in ninety minutes," Jack said. Travel between the landmasses was very fast.

Jenny was waiting to meet him at the shuttleport. The weather on Wings was indeed lovely—not a cloud in the sky. Jenny looked good too.

"Let's not be taken in by the blue skies," Jack said to her. "A bolt from the blue may be just the sort of thing the birds try to warn about."

"I know," Jenny said. "I thought of that. But weather's my profession. I spoke to the people at the laboratory af-

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ter we got off the phone—I've got the top man on this planet, and the best equipment, scrutinizing every vector on Wings and the nearest continents. The computers say there's less than a three percent chance of any rain activity, let alone thunderstorms, in this area. You can't get much more conclusive than that."

"Well, reality—what actually happens—always trumps a projection," Jack said.

"Of course," Jenny said. "I'm just saying—"

"I know," Jack said. "You were right to do the weather projections. I just don't want us to let our guard down. Can we go to the exact spot where they heard the suspended fourth?"

Jenny nodded, and flagged a ground transport.

Wings was bustling with all kinds of activity—the newest and last of the land masses to have been opened up to settlement.

"You know, it could be dangerous to go to the exact spot where the suspended fourth was heard," Jack said. "If I'm right about what that means, some kind of event leading to a fatality could occur there." He took his eyes off the pageantry of people and colors whirring by, and looked at Jenny.

"I realize that," Jenny said. "But what choice do we have if we want to investigate this?"

"You don't have to risk your life on this," Jack said. "You set the wheels in motion, you got me down here, that's more than enough. I'm the one with the personal mission."

"I'm doing what I want to," Jenny said. She pulled a sound device out of her pocket. "I interviewed seven more people who were in the area last night. Four said they recalled hearing something like the suspended fourth."

"Good work," Jack said. "One other question, though. How come you waited until morning to call me?"

"I was struggling with whether another wild goose chase would do you more harm than good."

They reached the site a few minutes later—an outdoor café that had sprung up on a hill on the side of the road, specializing in the local equivalent of clams and mussels in zesty Italian sauces whose recipes had made the trip across the stars.

"Customers were having a late-night bite here yesterday, when they heard the suspended fourth," Jenny said. "They say it was distant, but clear. The birds apparently repeated it several times, in the midst of what one man said was a neo-blues interlude. There were about twenty other people sitting around the tables then. This was the primary location."

"Looks like about twice that number now," Jack said. "Shall we join them? It looks like we can still get lunch."

Jenny nodded. A waiter seated them, and gestured to the menu-screens embedded on the table.

Jenny lit hers up. "The locals swear by the seafood," she said. "It's all been tested a dozen times to Sunday for human consumption, of course. You'll have no problem with it—unless you have uncorrected allergies."

"I love seafood," Jack said, and quickly lit up his menu and pressed the mussels marinara.

"Those mussels are delicious," Jenny said. "Tastier than ours on Earth. Almost no underlying grit, and with sort of a smooth, plum flavor. We give the same names to familiar things we find on other planets, but there are always differences. In this case, it's for the better."

Jack nodded and looked at the sky.

"I still can't get over how much this sun looks like Sol," he said. "Maybe a little bigger, but the same color."

Jenny placed her order—for steamers—and stole a quick squint at the local sun. "Delta Pavonis is a bit bigger—and brighter—than Sol, but we're a bit fur-

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ther away, which is why it's just a little more chilly here, on average, than it is where we come from." She breathed in the fresh air. "But it suits me just fine."

"So you're becoming a permanent resident?" Jack said, his eyes still on the sky.

"Yeah," Jenny replied. "I'm working at the local climate lab on Beak now. I guess I've had enough starfaring for a while—"

"Jesus," Jack said. "What's that?"

Jenny followed his finger to the sky. A large nimbus cloud had suddenly appeared, and was drifting towards the sun.

"So much for your fine scientific projections—" Jack began.

Their waiter approached, dishes in hand.

Jack glowered at Jenny, the sky, the waiter, as a plate of fragrant mussels was laid in front of him.

"Is everything all right, sir? Can I get you something to drink? Chablis?"

"Water's fine," Jack grunted.

"Same for me," Jenny said.

The waiter nodded and retreated.

Jack pushed his chair away from the table.

Jenny whispered. "What do you propose we do? Tell everyone on this patio to take cover? One of the women I interviewed heard the suspended fourth across the street. A kid on a bicycle heard it down the road, maybe half a mile away. There's no telling where the lightning might strike, or even if there will be lightning at all. All we have so far is a dark cloud that I admit our projections missed."

"You're crazy," Jack said. He stalked off to find the cafe's proprietor.

Jenny followed a minute later. She found Jack gesturing to Leonardo, one of the owners.

Leonardo looked at her for guidance—she had impressed him with her intelligence earlier in the day.

"He may be right," Jenny said quickly, about Jack. "There could be some really nasty weather coming this way. Maybe you should urge everyone to go indoors until it blows over."

"We have no room inside," Leonardo protested.

"Well, then let them take their plates, and go someplace safe," Jenny said.

Now Leonardo looked at her like she was insane. He muttered in Italian, then made an announcement in English, the language of the stars, on the loudspeaker.

Jack and Jenny retrieved their food, and made their way to an indoor mall across the street. The place was soon packed with clanking plates and discontented patrons of the outdoor café.

Jack took a look outside. The gray cloud hung overhead.

"We should get some kind of public announcement out to the people around here," Jack said.

Jenny made the calls. Outdoor vendors took cover, cursing. Toddlers were scooped up from beaches and playgrounds by their parents. A recalcitrant couple ignored the announcement, and proceeded to make love behind a huge maplelike tree at the edge of the forest that trimmed the settlement. . . .

But the cloud was gone half an hour later, without incident.

Jack and Jenny took the slow way to the shuttleport—a long walk on a road that turned into a flat, grassy footpath. Jack took her hand, as they approached the gate. "Thank you," he said, quietly, "for at least believing in me enough to back me up back there."

"I do believe in you," Jenny said. "I admire people willing to move Heaven and Earth to pursue an idea—that's what got our species out here in the first place. But . . ."

"I know," Jack said. "You don't need to say it."

"I have to say it," Jenny said. "I believe in *you,* but that doesn't mean I—or you—have to keep believing in this idea. You've given enough in pursuit of this suspended fourth—you've suspended

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your life for it. You don't have to do it anymore."

"I don't know if I can give it up," Jack said.

Jenny looked at him. Then she kissed him, and pulled away. "Well, you think about it," she said. "And if you think you might be able to give it up, you'll know where to find me. My shuttle leaves in the evening, then I'm back on Beak." And she turned and walked away.

Jack looked up at the sky, then through the gate of the shuttleport, and then at Jenny's receding body. She was receding too fast. He liked what she looked like.

He thought about running after her.

He turned again to the shuttle gate—his shuttle would be boarding in twenty minutes.

He looked again at Jenny—and something caught his eye, in the corner of the sky . . .

He walked a few feet from the gate. He strained to get a better look, but couldn't quite make it out—

A call for shuttle-boarding boomed forth, but he could barely hear it.

He was concentrating on Jenny. He could barely see her now.

But the thing in the sky was clearer. It was gleaming . . .

"Jenny! Jenny!" he shouted, and ran after her, full speed.

He was in a race—he on the ground, the machine in the sky. It seemed like they both were rushing in convergent lines that led straight to Jenny. The question was which one would get to her first . . .

"Jenny!" he shouted again, and again, but she was still too far away to hear him . . .

His blood pounded in his ears, his breath cut through his chest . . .

"Jenny, look at the sky . . ."

It was clear as day to him now. A goddamn bull-droid, way off course, hurtling in the sky where it had no place being, right towards Jenny . . .

"Jenny!"

Must have been some damn programming error that had made it crash two years ago, and now this one . . .

It was making so much noise—how could she not hear it—

"Jenny!"

Now she turned to look at him, then up at the thing in the sky.

It was whirling way out of control—

She tried to dodge it, but there was no telling where exactly it would crash—

It looked to Jack like it was making contact with her now, but she was still running, so that must be an illusion, and he was so close—

It hit the ground and burst into flames that engulfed Jenny, just as he reached her . . .

He grabbed her hand and pulled her away from the flames . . .

They ran and stumbled and both fell down. The bull-droid exploded, and the world went red and black—

His body was on top of hers. The air felt hot.

He held her face in his hands and kissed it all over. "Jenny, please be OK . . ."

Her arms went around him and her mouth against his . . .

"I'm sorry I didn't believe you," she murmured.

"It's OK, it's OK, you're all right." And they stayed that way for a long time . . .

Dinesh flew in the next day, and joined them for lunch at the outdoor cafe.

The site of the bull-droid crash was a blackened scar, plainly visible down the road.

"You were right, I was wrong," Dinesh said. He gestured at the burnt patch, and extended his hand to Jack.

Jack shook it, and motioned Dinesh to sit.

"Thank you," Jack said, "but I can't say I understand exactly how. What made the birds warn us about this bull-droid crash, and not the one two years ago?"

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"They had no experience with our bull-droids," Dinesh said, and ordered clams in a light wine sauce. "How could they? No bull-droids were on this planet until we arrived."

"So they learned from the first experience—the first time the bull-droid crashed," Jenny said.

"Precisely," Dinesh replied. "Even on Earth, birds are extremely observant—they can make very fine discriminations about where food is, the best route to travel, based on the tiniest changes in the environment."

"So they observed the defective bull-droid the first time," Jack said.

"Right," Dinesh said. "They saw something in its behavior before it crashed that was unusual—however slight a difference, but unusual. And they associated the aftermath—the deadly crash—with this slight difference. Perhaps the bull-droid wobbled slightly when it flew, perhaps it listed a few feet, who knows. But whatever it was, it tipped off the birds. So, when they saw it again, they knew what it could lead to. So they sang out the suspended fourth in their song."

"What the hell kind of intelligent birds are these?" Jack asked.

"Not necessarily intelligent—but well bred, or genetically engineered, to be able to sound alarms like this," Dinesh replied.

"Maybe they evolved that way through natural selection," Jenny said. "How can we know that these guardian angels were deliberately bred to sound warnings?"

"Think of who benefits from their suspended fourths," Dinesh said. "The birds weren't hurt in the bull-droid crashes—we were the victims. And birds usually sit out thunder and lightning just fine. No—they were bred to benefit someone else—their breeders. And our species is lucky enough to have been the beneficiary."

"I guess more than one bird species inserting suspended fourths in their songs supports that," Jenny agreed after consideration. "Natural selection gave them different shapes, sizes, colors, songs. Why would it give them all the same chord?"

"I knew it," Jack said. "I knew it about the lightning." And his eyes got teary, but he reached for Jenny's hand.

"Yes, you were right about that, too," Dinesh said. "We were close to understanding that before. There must be some sort of subtle, peculiar weather condition on this planet that engenders sudden thunderstorms with lightning. The birds were bred to alert everyone to that. But even more impressive—"

"They were bred to learn—to learn about new dangers, and work those into their repertoires," Jenny said.

"Exactly," Dinesh said. His clams arrived.

"There's nothing like those birds back on Earth," Jack said.

"Not that we know of, no," Dinesh replied.

"So who bred them here?" Jack asked.

"The science teams found no trace of any intelligent manipulation on this planet," Jenny said.

Dinesh smiled. "Well, it seems our California Dreamers proved them wrong."

The birds sang something in the distance. It wasn't "California Dreamin'," but it came to rest in a wash of new horizons nonetheless. . . .■

Common sense does not ask an impossible chessboard, but takes the one before it and plays the game.

— Wendell Phillips

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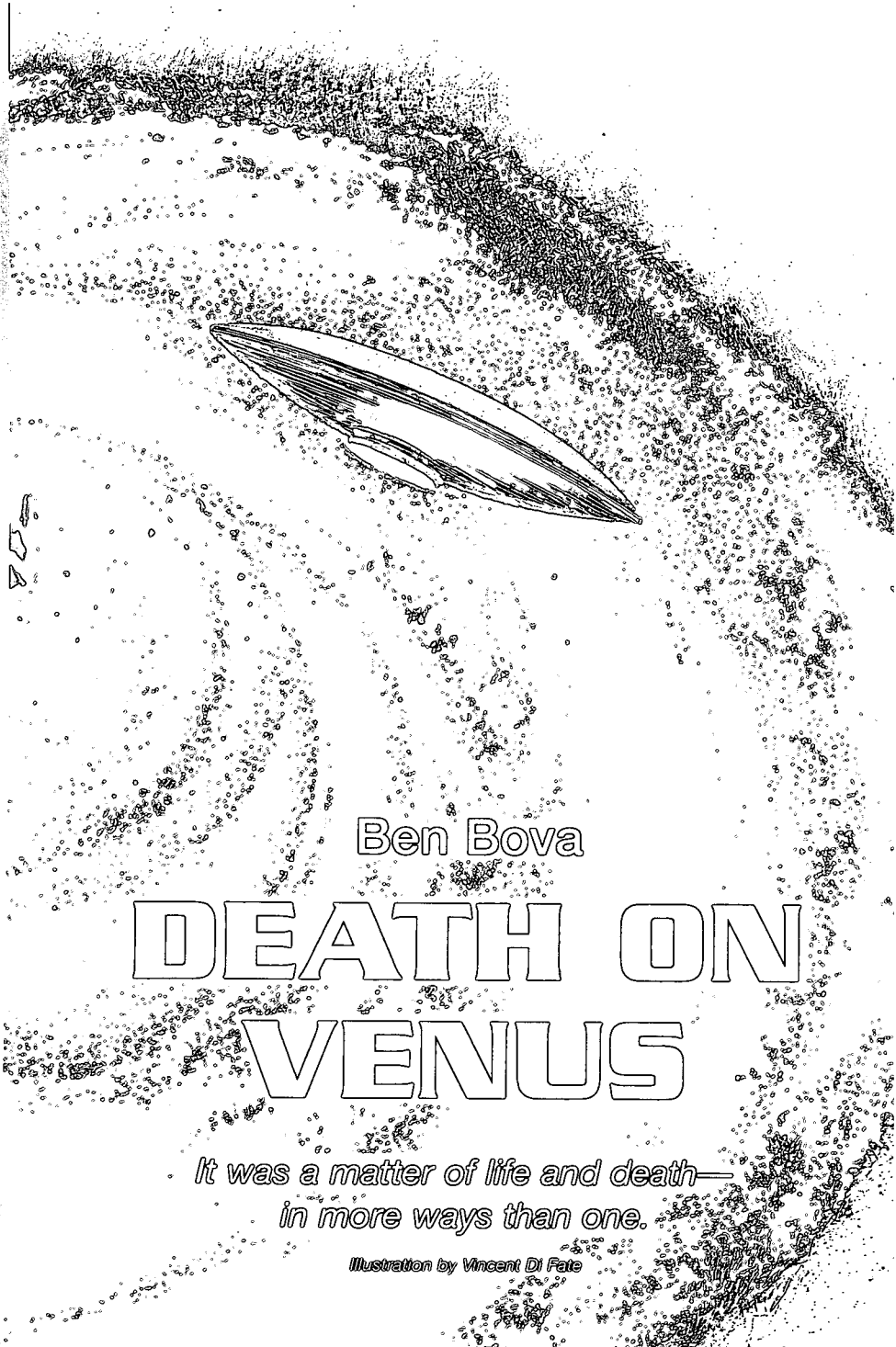

Ben Bova

DEATH ON VENUS

It was a matter of life and death—
in more ways than one.

Illustration by Vincent Di Fate

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My name is Van Humphries. I will be the first human being to reach the hell-hot surface of the planet Venus, or I will die in the attempt.

My father gave me no other choice.

All my life my father had looked down on me; despised me and my illness, sneeringly called me "Runt." Sick from birth, I'd been born with a form of pernicious anemia because of my mother's drug addiction. She had died giving birth to me, and my father blamed me for her death. He claimed she was the only woman he had ever truly loved, and I had killed her.

Father—Martin Humphries—lived in Selene City on the Moon where he played his chosen roles of interplanetary tycoon; megabillionaire; hell-raising, womanizing, ruthless corrupt giant of industry; founder and head of Humphries Space Systems, Inc.

My older brother, Alex, was the apple of Father's eye. But three years ago Alex was killed on the first human mission to Venus. His ship entered the clouds that totally cover our sister planet, but never came out again.

"It should've been you, Runt!" Father howled when we got the news. "It should've been you who died, not Alex."

Father stewed in helpless fury for months, then suddenly announced that he would give a ten-billion-dollar prize to whoever returned Alex's remains to him.

Ten billion dollars! I would have thought that half the world would leap at the chance to claim the prize. But then I realized that no one in his right mind would dare to try.

As beautiful as Venus appears in our skies, the planet itself is the most hellish place in the solar system. The ground is hot enough to melt aluminum. The air pressure is so high it has crushed spacecraft landers as if they were flimsy cardboard cartons. The sky is perpetually covered from pole to pole with clouds of sulfuric acid. The atmosphere is a choking mixture of carbon dioxide and sulfurous gases.

But Martin Humphries wanted his son's remains returned to him. So he offered his ten-billion-dollar prize.

And he did one other thing. He cut off my stipend, as of my twenty-fifth birthday. On that date I became penniless.

I had loved Alex, the big brother who'd protected me as best as he could from Father's cruel disdain. I decided that *I* would go to Venus and find his remains.

If I was successful, I would be financially secure and independent of Father for the rest of my life.

If I failed, I would join Alex on the red-hot surface of Venus.

I was not the only desperate one aiming for the prize money, I discovered. Lars Fuchs, a "rock rat" from the Asteroid Belt, was also on his way to Venus. From what Father told me, Fuchs was a monster. I had never seen my father look so disturbed about anyone. My father hated Lars Fuchs, that was apparent. He was also quite clearly afraid of him.

We travelled from Earth orbit to Venus orbit in a converted freighter named *Truax*. Tethered to the shabby old bucket was *Hesperos*, the craft that we would ride into the clouds of Venus and down to the planet's surface. *Hesperos* was small but efficient, a cross between a dirigible and submarine that would glide through Venus' thick clouds and carry us all the way down to the ground, where the atmospheric pressure was about the same as the pressure of ocean water more than a kilometer below the surface.

I had wanted Tomas Rodriguez to captain *Hesperos*, but Father had insisted on putting one of his former mistresses in charge, Desiree Duchamp. Tomas reluctantly accepted being bumped to second-in-command. Captain Duchamp, in turn, brought her daughter along. Marguerite was a biologist, of all things.

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Who needed a biologist on a planet as dead and devastated as Venus?

I soon found out two things: Captain Duchamp wanted her daughter with her because my lecherous father had his eye on her. And Marguerite Duchamp was a clone of her mother.

As Marguerite explained to me, "Mother's always said she's never met a man she'd trust to father a child with her. So she cloned herself and had the embryo implanted in herself. Eight and a half months later I was born."

It was a tense two months, going from Earth to Venus. At last the day arrived when we were to transfer from *Truax* to *Hesperos,* leaving the old freighter in orbit with a skeleton crew aboard her.

I took one last look at my stateroom. When we had boarded *Truax* the single room had seemed rather cramped and decidedly shabby to me. Over the nine weeks of our flight to Venus, though, I'd grown accustomed to having my office and living quarters all contained within the same four walls—or bulkheads, as they're called aboard ship. At least the smart wall screens had made the compartment seem larger than it actually was.

Now we were ready to transfer to the much smaller *Hesperos*. At least, the crew was. I dreaded the move. If *Truax* was like a tatty old freighter, *Hesperos* would be more like a cramped, claustrophobic submarine.

To make matters worse, in order to get to the dirigible-like *Hesperos* we were going to have to perform a spacewalk. I was actually going to have to seal myself into a spacesuit and go outside into that yawning vacuum and trolley down the cable that linked the two vessels, with nothing between me and instant death but the monomolecular layers of my suit. I could already feel my insides fluttering with near panic.

For about the twelve-thousandth time I told myself I should have insisted on a tugboat. Rodriguez had talked me out of it when we'd first started planning the mission. "A pressurized tug, just so we can make the transfer without getting into our suits?" he had jeered at me. "That's an expense we can do without. It's a waste of money."

"It would be much safer, wouldn't it?" I had persisted.

Tomas Rodriguez had been an astronaut; he'd gone to Mars four times before retiring upward to become a consultant to aerospace companies and universities doing planetary explorations. Yet what he really wanted was to fly again.

He was a solidly built man with an olive complexion and thickly curled hair that he kept clipped very short, almost a military crew cut. He looked morose most of the time, pensive, almost unapproachable. But that was just a mask. He smiled easily, and when he did it lit up his whole face to show the truly gentle man beneath the surface.

But he was not smiling; he looked disgusted. "You want safety? Use the mass and volume we'd need for the tug to carry extra water. That'll give us an edge in case the recycler breaks down."

"We have a backup recycler."

"Water's more important than a tug that we'll only use for five minutes during the whole mission. That's one piece of equipment that we definitely don't need to carry along."

So I had let Rodriguez talk me out of the tug. Now I was going to have perform an EVA, a space walk, something that definitely gave me the shakes.

My jitters got even worse whenever I thought about Lars Fuchs.

Once my father told me that Fuchs actually was racing for the prize money, I spent long hours digging every byte of information I could glean about him. What I found was hardly encouraging. Fuchs had a reputation for ruthlessness and achievement. According to the media biographies, he was a merciless taskmaster, a driven and hard-

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driving tyrant who ran roughshod over anyone who stood in his way. Except my father.

The media had barely covered Fuchs' launch into a high-velocity transit to Venus. He had built his ship in secrecy out in the Belt—adapted an existing vessel, apparently, to his needs. Unlike all the hoopla surrounding my own launch from Tarawa, there was only one brief interview with Fuchs on the nets, grainy and stiff because of the hour-long delay between the team of questioners on Earth and Fuchs, out there among the asteroids.

I pored over that single interview, studying the face of my adversary on my stateroom wall screen, in part to get my mind off the impending space walk. Fuchs was a thickset man, probably not much taller than me, but with a barrel chest and powerful-looking shoulders beneath his deep blue jacket. His face was broad, jowly, his mouth a downcast slash that seemed always to be sneering. His eyes were small and set so deep in his sockets that I couldn't make out what color they might be.

He made a grisly imitation of a smile to the interviewers' opening question and replied, "Yes, I am going to Venus. It seems only fair that I should take this very generous prize money from Martin Humphries—the man who destroyed my business and took my wife from me more than thirty years ago."

That brought a barrage of questions from the reporters. I froze the image and delved into the hypertext records.

Fuchs had an impressive background. He had been born poor, but built a sizable fortune for himself out in the Asteroid Belt, as a prospector. Then he started his own asteroidal mining company and became one of the major operators in the Belt, until Humphries Space Systems undercut his prices so severely that Fuchs was forced into bankruptcy. HSS then bought out the company for a fraction of its true worth. My father had personally taken control and fired Fuchs from the firm that the man had founded and developed over two decades.

While Fuchs stayed out in the Asteroid Belt, penniless and furious with helpless rage, his wife left him and married Martin Humphries. She became my father's fourth and last wife.

I gasped with sudden understanding. She was my mother! The mother I had never known. The mother who had died giving birth to me six years afterward. The mother whose drug addiction had saddled me with chronic anemia from birth. I stared at her image on the screen: young, with the flaxen hair and pale blue eyes of the icy northlands. She was very beautiful, yet she looked fragile, delicate, like a flower that blooms on a glacier for only a day and then withers.

It took an effort to erase her image and go back to the news file. Fuchs had taken off for Venus in a specially modified ship he had named *Lucifer*. The Latin name for Venus as the morning star was Lucifer. It was also the name used by the Hebrew prophet Isaiah as a synonym for Satan.

Lucifer. And Fuchs. After a high-*g* flight, he was already in orbit around Venus, more than a week ahead of me. Sitting there in my stateroom, staring at Fuchs' sardonic, sneering face on the wall screen, I remembered that the time had come to transfer to *Hesperos*. There was no way to get out of it. I still wished I was home and safe, but now I knew that I had to go through with this mission no matter what the dangers.

But my thoughts went back to my mother. I had never known that she was once Fuchs' wife. My father hardly ever spoke of her, except to blame me for her death. Alex had told me that it wasn't my fault, that women didn't die in childbirth unless there was something terribly wrong. It was Alex who told me about her drug dependency; as far as my father was concerned she was faultless.

"She was the only woman I ever really loved," he said, many a time. I almost

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believed him. Then he would add, cold as liquid helium, "And you killed her, Runt."

A single rap on my door startled me. Before I could respond, Desiree Duchamp slid the door open and gave me a hard stare.

She wore the same dun-colored flight coveralls as everyone else aboard ship, but on her they looked crisper, sharper, almost like a military uniform. Her eyes were large and luminous. She might have been beautiful if she would smile, but the expression on her face was severe, bitter, almost angry.

"Are you coming or not?" she demanded.

I drew myself up to my full height—not quite eye to eye with my captain—and forced my voice to be steady and calm as I answered, "Yes. I'm ready."

When she turned and headed down the passageway I squeezed my eyes shut and tried to conjure up a picture of my brother. I'm doing this for you, Alex, I said to myself. I'm going to find out why you died—and who's responsible for your death.

But as I headed down the passageway after Duchamp, the image in my mind was of my mother, so young and lovely and vulnerable.

We had done simulations of the EVA procedure a dozen times, and I had suited up each time. I thought it was silly, like children playing dress-up, but Duchamp had insisted that we pull on the cumbersome suits and boots and helmets and backpacks even though we were only going to play-act in *Truax*'s virtual reality chamber.

Now the crew was gathered at the main airlock, busily getting into their spacesuits. It looked to me like the changing room in some athletic team's locker, or a beachside cabana. I paid intense attention to every detail of the procedure, though. This time it would be for real. A mistake here could be fatal. Leggings first, then the thickly lined boots. Slide into the torso and wiggle your arms through the sleeves. Pull the bubble helmet over your head, seal it to the neck ring. Then work the gloves over your fingers. The gloves had a bony exoskeleton on their backs, powered by tiny servomotors that amplified one's muscle power tenfold. There were also servos built into the suit's joints: shoulders, elbows, knees.

Duchamp herself hung the life-support rig on my back and connected the air hose and power lines. The backpack felt like a ton weighing on my shoulders.

I heard the suit's air fans whine into life, like distant gnats, and felt cool air flowing softly across my face. The suit was actually roomy inside, although the leggings chafed a little against my thighs.

Marguerite, Rodriguez and the four other crew members were all fully suited. Even Dr. Waller, our rotund, dark-skinned Jamaican physician with the sunny disposition, was frowning slightly with impatience as they waited for me to finish up.

"Sorry I'm so slow," I muttered.

They nodded from inside their fishbowl helmets. Marguerite even managed a little smile.

"All right," Duchamp said at last, once she was convinced my suit was properly sealed. "Radio check." Her voice was muffled slightly by the helmet.

One by one the crew members called to the EVA controller up on the bridge. I heard each of them in my helmet earphones.

"Mr. Humphries?" the controller called.

"I hear you," I said.

"Radio check complete. Captain Duchamp, you and your crew are go for transfer."

With Duchamp directing us, we went through the airlock hatch, starting with Rodriguez. Then the doctor and, one by one, the three technicians. I followed Marguerite. Captain Duchamp grasped my arm as I stepped carefully over the sill of the hatch into the blank metal womb of the airlock.

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Once she swung the inner hatch shut I felt as if I were in a bare metal coffin. I started to breathe faster, felt my heart pumping harder. Stop it! I commanded myself. Calm down before you hyperventilate.

But when the outer hatch started to slide open I almost panicked.

There was nothing out there! They expected me to step out into total emptiness. I tried to find some stars in that black infinity, something, anything to reassure me, but through the deep tinting of my helmet I could not see any.

"Hold on." Rodriguez's familiar voice calmed me a little. But only a little. Then I saw the former astronaut—now an astronaut once again—slide into view, framed by the outline of the open hatch.

"Gimme your tether," Rodriguez said, extending a gloved hand toward me. It looked like a robot reaching for me. I couldn't see his face at all. Even though the bubble helmets gave us fine visibility from inside them, their protective sunshield tinting made them look like mirrors from the outside. All I could see in Rodriguez's helmet was the blank fishbowl reflection of my own helmet.

"C'mon, Mr. Humphries. Gimme your tether. I'll attach it to the trolley. Otherwise you'll swing away."

I remembered the drill from the simulations we had gone through. I unclipped one end of my safety tether from its hook at the waist of my suit and handed it mutely to Rodriguez. He disappeared from my view. There was nothing beyond the airlock hatch that I could see, nothing but a gaping, all-encompassing emptiness.

"Step out now, come on," Rodriguez's voice coaxed in my earphones. "You're okay now. Your tether's connected to the trolley and I'm right here."

His spacesuited form floated into view again, like a pale white ghost hovering before me. Then I saw the others, a scattering of bodies floating in the void, each connected to the trolley by thin tethers that seemed to be stretched to their limit.

"It's really fun," Marguerite's voice called.

We were not in zero gravity. The two spacecraft were still swinging around their common center of gravity, still connected by the Buckyball cable. But there was nothing out there! Nothing but an emptiness that stretched to the ends of the universe.

Shaking inside, my heart thundering so loudly that I knew they could all hear it over my suit radio, I grasped the edge of the outer hatchway in my gloved hands and, closing my eyes, stepped off into infinity.

My stomach dropped away. I felt bile burning up into my throat. My mind raced. He missed me! Rodriguez missed me and I'm falling away from the ship. I'll fall into the Sun or go drifting out and away forever and ever.

Then something tugged at me. Hard. My eyes popped open and I saw that my tether was as taut as a steel rod, holding me securely. But the trolley seemed to be miles away. And I couldn't see any of the others even when I twisted my head to look for them.

"He's secured," Rodriguez's voice said in my earphones.

"Very well," Duchamp replied. "I'm coming out."

I was twisting around, literally at the end of my tether, trying to find the rest of us.

Then the massive bulk of Venus slid into my view. The planet was huge! Its tremendous mass curved gracefully, so bright that it was hard to look at it even through the heavy tinting of my helmet. For a dizzying moment I felt as if its enormous expanse was above me, over my head, and it was going to come down and crush me like a ponderous boulder squashing some insignificant bug.

But only for a moment. The fear passed quickly and I gasped as I stared at the overpowering awesome immensi-

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ty of the planet. Tears sprang to my eyes, not from its brightness, from its beauty.

I felt someone tugging at my shoulder. "Hey, you okay, boss?" Rodriguez asked.

"Wha . . . yes. Yes, I'm all right."

"Don't freeze up on us now," the astronaut said. "We'll be ready to move soon's Duchamp gets herself connected to the trolley."

I couldn't take my eyes off Venus. She was a brilliant saffron-yellow expanse, glowing like a thing alive. Goddess of beauty, sure enough. At first I thought the cloud deck was as firm and unvarying as a sphere of solid gold. Then I saw that I could make out streamers among the clouds, slightly darker stretches, patches where the amber yellowish clouds billowed up slightly.

I was falling in love with a world.

"I'm secured. Let's get moving." Duchamp's terse order broke my hypnotic staring.

Turning my entire body slightly I saw the seven other figures bobbing slightly around the trolley, which was nothing more than a motorized framework of metal struts that could crawl along the Buckyball cable.

I looked down the length of the cable toward *Hesperos*, which seemed to be kilometers away. Which it was: three kilometers, to be exact. At that distance the fat dirigible that was our spacecraft looked like a toy model or a holographic image of the real thing. At its nose the broad cone of the heat shield stood in place like a giant parasol, looking faintly ludicrous and totally inadequate to protect the vessel from the burning heat of entry into those thick yellow clouds.

"All right, by the numbers, check in," Duchamp commanded.

As the crew members called in I thought again of what a farce Marguerite's "official" title of mission scientist was. But I was glad she was with us. I could talk to her. She didn't lord it over me as her mother did; even Rodriguez made it clear, without realizing he was doing it, that he regarded me as little more than a rich kid playing at being a scientist.

"All right, then," Duchamp said. "Captain to *Truax*. We are ready for transfer."

"Copy you ready for transfer, Captain. *Hesperos* main airlock is cycled, outer hatch open and waiting for your arrival."

"Activate trolley," she commanded.

"Activating."

I felt a very slight tug on my tether, and then all of us were moving toward the distant *Hesperos*, accelerating now, sliding down the long Buckyball cable like a small school of minnows flashing across a pond. *Hesperos* seemed to be coming up at us awfully fast; I thought we'd crash into her, but I kept silent. Sometimes you'd rather die than make an ass of yourself.

Sure enough, the trolley smoothly decelerated, slowly coming to a stop as the seven of us swung on our tethers like a trained team of acrobats in a silent ballet until we were facing down toward *Hesperos*. I marvelled that we went through the maneuver without bumping one another, but Rodriguez later told me it was simple Newtonian mechanics at work. My respects to Sir Isaac.

The trolley stopped about ten meters from the open airlock hatch, with us hanging by our tethers with our boots a mere meter or so from *Hesperos'* hull. As we had done in the virtual reality simulations, Duchamp unhooked her tether and dropped to the hatch, her knees bending as her boots hit the hull soundlessly.

She stepped into the airlock, disappearing into its shadowed depth for a moment. Then her bubble helmet and shoulders emerged from the hatch and she beckoned to me.

"Welcome aboard, Mr. Humphries," she said. "As owner, you should be the first to board *Hesperos*. After me, of course."

"I've tried to contact him a dozen times, Mr. Humphries," said the commu-

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nications technician. "He simply doesn't answer."

It was the longest sentence the comm tech had spoken to me since I'd first met her. Her name was Riza Kolodny. She was a plain-looking young woman with a round face and mousey brown hair that she kept short, in the chopped-up look that had been fashionable a couple of years earlier.

I was bending over her shoulder, staring at the hash-streaked communications screen. Riza was chewing something that smelled vaguely of cinnamon, or perhaps it was clove. She seemed apprehensive, perhaps afraid that she was displeasing me.

"I've tried all the comm freaks," she said, lapsing into jargon in her nervousness, "starting with the frequency Captain Fuchs registered with the IAA. He just doesn't answer."

Hesperos was not built for creature comforts. The tubular gondola that hung beneath the vessel's bulbous gas envelope housed a spare and spartan set of compartments that included the bridge, galley, a single lavatory for all eight of us, work spaces, infirmary, supply lockers, and our so-called living quarters—which were nothing more than slim, coffin-sized berths partitioned off for a modicum of privacy. There was no room aboard *Hesperos* for anything but utilitarian efficiency. We all felt crowded, cramped. I had to fight off incipient claustrophobia whenever I slid into my berth; I felt like Dracula coming home for a good day's sleep.

The bridge was especially cramped. The comm center was nothing more than a console shoehorned in a bare few centimeters from the captain's command chair. I had to twist myself into a pretzel shape to get close enough to Riza's chair to see her screen. I could feel Duchamp's breath on the back of my neck; she was ignoring me, her dark eyes intently focused on the EVA displayed on the main screen before her. Rodriguez and the two other techs were outside in their spacesuits, clambering over the heat shield, checking every square centimeter of it.

"Maybe Fuchs' ship has broken down," I thought aloud. Wishful thinking, actually. "Maybe he's in trouble."

Riza shook her head, fluttering her butchered hairdo. "*Lucifer* is telemetering its systems status back to IAA headquarters on the regular data channel, same as we are. The ship's still in orbit with all systems functional."

"Then why doesn't he answer our call?" I wondered.

"He doesn't want to," said Duchamp.

I turned to face her, not exactly an easy thing to do in the jammed confines of the bridge.

"Why not?"

She gave me a frosty smile. "Ask him."

I glared at her. She was making a joke of my effort to contact Lars Fuchs. There was only the three of us on the bridge; Rodriguez's chair was empty.

"I could relay our call through IAA headquarters," Riza suggested. "He might reply to us if the request came through them."

"He won't," Duchamp said flatly. "I know Fuchs. He's not talking to us because he doesn't want to. And that's that."

Reluctantly, I accepted her assessment of the situation. Fuchs was going to remain silent. The only way we would learn of what he was doing would be to access whatever data he was sending back to the International Astronautical Authority in Geneva.

"Very well," I said, squeezing between Duchamp and the display screen she was watching. "I'm going to the observation port to do my news broadcast."

"Stay clear of the airlock," Duchamp warned. "Tommy and the others will be coming back in less than ten minutes."

"Right," I said as I ducked through the hatch. The main passageway ran the length of the gondola; it was so narrow that Rodriguez joked that a man could

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fall in love squeezing past someone there.

Before we left Earth the question of news coverage had come up. Should we bring a reporter along with us? Back when I thought I'd be bringing some of my friends along on the journey, I had been all in favor of the idea. I thought the nets would *love* to send a reporter to Venus, and I had several friends who could qualify for the role. Live broadcasts from the mission couldn't fail to get top ratings, I figured. Unfortunately, the net executives saw it differently. They pointed out to me that newscasts from *Hesperos* would be interesting the first day or two, but they'd quickly become boring on the long voyage out to Venus. They admitted that once we got there, live reports from Venus would be a sensational story—again, for a day or two. But afterward the story would lose its glamour and become nothing but colorless, tedious routine.

"It's science stuff," one of the junior executives—a sometime friend of mine, in fact—told me. "Science stuff is boring."

They certainly were not willing to pay a reporter's expenses, and insurance. It was Duchamp who suggested that I serve as the expedition's reporter, the face and voice of the *Hesperos'* mission. "Who better?" she asked rhetorically. I liked the idea. It eliminated the need to carry an extra person along with us. I would file a personal report on the expedition's progress every day. I would become a household figure all around the Earth/Moon system. I really thought that would be terrific. Even if the nets wouldn't feature my broadcasts every day, people could access them whenever they wanted. I often wondered, as I went through my daily report, if my father ever watched me.

Duchamp was no fool. Removing the need to bring a reporter with us she also removed any possible objections I could raise about her replacing our astronomer with a biologist. Her daughter. Fait accompli. She had manipulated me beautifully and I hardly even minded it, although we both knew we didn't need a biologist aboard. Duchamp did it for personal reasons.

Yet I didn't mind. I was actually pleased that Marguerite was with us. Except for my daily news report I had no real duties aboard *Hesperos*. Time hung heavily as we coasted out to Venus and then established orbit around the planet. Marguerite had little to do, also, as far as ship's duties were concerned, although she usually seemed busy enough when I went looking for her.

Often she was in the little cubbyhole that had been converted into her laboratory. After leaving the bridge and heading for the observation port in the nose of the gondola, I naturally passed by her lab. It was smaller than a phone booth, of course.

The accordion-fold door was slid back, so I stopped and asked her, "Are you busy?"

"Yes," said Marguerite. It was a silly question. She was pecking at the keyboard of a laptop, one of several she had propped along the compartment's chest-high shelf. There was no room in her lab for a chair or even a stool; Marguerite worked standing up.

"Oh. I was on my way to do my news report and I thought I'd stop in the galley for a few minutes . . ." My voice trailed off; she was paying no attention to me, tapping at the keyboard of one laptop with a finger while she clicked away on a remote controller with her other hand, changing the images on one of her other screens. The images looked like photomicrographs of bacteria or something equally distasteful. Either that or really bad primitive art.

I shrugged, conceding defeat, and continued down the narrow passageway to the galley. It was nothing more than a set of food freezers and microwave ovens lining one side of the passageway, with a single stark bench on the other side, where one of the gondola's oblong windows showed the mas-

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sive, curving bulk of the planet below, gleaming like a gigantic golden lamp.

I slumped down on the bench and gazed out at Venus' yellowish clouds. They shifted and changed as I watched. It was almost like staring into a fire, endlessly fascinating, hypnotic. The clouds' hue seemed to be slightly different from one orbit to another. At the moment they looked almost sickly, bilious. Maybe it's just me, I reasoned. I felt like that, sad and sick and alone.

"Mind if I join you?"

I looked up and there was Marguerite standing over me. I shot to my feet.

"Pull up a section of bench," I said brightly.

Marguerite was a physical duplicate of her mother. Younger, of course, not so taut or intimidating, yet the same tall, slim figure. The same sculptured cheekbones and strong jaw. The same jet black eyes and raven hair.

Where her mother was demanding and dominating, though, Marguerite seemed troubled, uncertain of herself. The mother wore her shoulder-length hair severely pulled back; the daughter's flowed softly, and was considerably longer.

Marguerite sat next to me and I caught a scent of perfume, very delicate, but a wonderful contrast to the metallic starkness of the ship.

"I'm sorry I was short with you back there," she said. "I was running the latest UV scans of the atmosphere. Sometimes it gets pretty intense."

"Oh, sure. I understand."

She was still wrapped up in her work. "*Something* down in those clouds absorbs ultraviolet light," she said.

"You think it's biological? A life-form in the clouds?"

She started to nod, then thought better of it. As if she were a long-experienced scientist, she buried her enthusiasm and answered noncommittally, "I don't know. Perhaps. We won't know for certain until we get down into the clouds and take samples."

Without thinking I argued, "What about all the sampling the unmanned probes did, years ago? They didn't find any evidence of living organisms."

Suddenly Marguerite's dark eyes snapped with annoyance. "They weren't equipped to. They all carried nephelometers to measure droplet size, but not one of them carried a single instrument that could have detected any biological activity. A Shetland pony could've flown by and those dumb-ass robots would never have noticed."

"There weren't any biological sensors on any of the probes?"

"Not one," she said. "Venus is a dead planet. That's the official word."

"But you don't believe it."

"Not yet. Not until I've looked for myself."

I felt a new respect for Marguerite. She could be just as much a tigress as her mother in matters that she cared about.

"How much longer will we stay in orbit?" she asked.

I hunched my shoulders. "We're scanning the equatorial region with radar, looking for any sign of the wreckage of my brother's ship."

"Wouldn't it be all smashed into small pieces?"

"Probably not," I answered. "The atmosphere's so thick that his ship would've gone to the bottom like a ship sinking in the ocean, back home. I mean, the pressure down at the surface is like our oceans, a kilometer or more below sea level."

She thought about that for a moment. "So it wouldn't be like a plane falling out of the sky on Earth."

"Or like a missile hitting the ground. No. More like the *Titanic* settling on the bottom of the Atlantic."

"You haven't found anything yet?"

"Not yet," I admitted. *Hesperos* was in a two-hour equatorial orbit; we had circled the planet thirty times, so far.

"How much of a chance is there that you'll spot something?"

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"Well, we know where he first entered the atmosphere, the latitude and longitude. But we can only guess where he might have drifted while he was in the clouds."

"He didn't have a tracking beacon?"

"Its signal broke up a lot once he went into the cloud deck, so we've got to scan a pretty wide swath along the equator."

Marguerite looked past me, out at the clouds swirling across the face of Venus. She stared at them as if she could get them to part by sheer willpower. I watched the profile of her face. How much she looked like her mother! The same face, yet somehow softer, kinder. It made me think about how little I looked like my father. Alex resembled Father. People had often exclaimed that Alex looked like a younger replica of Martin Humphries. But I resembled my mother, they said. The mother I never knew.

Marguerite turned back to me. "Are you really a planetary scientist?"

The question surprised me. "I try to be," I said.

"Then why aren't you working at it? There's your planet, right out there, and yet you spend your time wandering around the ship like a little lost boy."

"I've got a complete set of instruments taking data," I said. It sounded weak and defensive, even to me.

"But you're not doing anything with the data. You're not analyzing it or using it to change the sensors' operating parameters. You're just letting everything chug along on their preset programs."

"The data goes back to Professor Cochrane at Caltech. If she wants the instruments changed, she tells me and I make the changes."

"Like a graduate student," Marguerite said. "A trained chimpanzee."

That stung. "Well . . . I've got other things to do, you know."

"Like what?"

"I send in my news reports every day."

Her lips pulled down disapprovingly. "That must take all of ten minutes."

Strangely, I felt laughter bubbling up in me. I normally don't take kindly to criticism, but Marguerite had hit me fairly and squarely.

"Oh, no," I answered her, chuckling. "It takes more like half an hour."

Her expression softened, but only a little. "Well then, let's see. I'll give you eight hours for sleeping and an hour and a half for meals . . . that leaves fourteen empty hours every day! If I had fourteen hours on my hands I'd build a whole new set of biosensors for when we dip into the clouds."

"I could help you," I said.

She pretended to consider the offer. "Uh-huh. Do you have any background in cellular biology?"

"I'm afraid not."

"Spectroscopy? Can you take apart one of the mass spectrometers and realign it to be sensitive to organic molecules?"

I must have been grinning like a fool. "Um, do you have a manual for that? I can follow instruction manuals pretty well."

She was smiling now, too. "I think you'd better stick to your own specialty."

"Planetary physics."

"Yes. But get active about it! There's more to science than watching the readouts of your instruments."

"I suppose so. But so far the sensors aren't showing anything that the old probes didn't get, years ago."

"Are you certain? Have you gone through the data thoroughly? You mean to tell me there's *nothing* different? No anomalies, no unexplained blips in the incoming data?"

Before I could think of an answer, Duchamp's voice came through the intercom speaker built into the overhead. "Mr. Humphries, radar scan has picked up a glint that might be wreckage. Could you come to the bridge, please?"

Rodriguez was back on the bridge

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when we got there, and with all three chairs occupied, the bridge was simply too small for both me and Marguerite to squeeze in. I ducked halfway through the hatch and stopped there. Marguerite stayed behind me, in the passageway, and looked in over my shoulder.

The main screen, in front of Duchamp's command chair, showed a frozen radar image: dark shadows and jumbled shapes of landforms with a single bright glint at its center. Rodriguez was leaning forward in his chair, studying the image, perspiration beading his brow.

"That could be it," he said, pointing to me. "It's definitely metal; the computer analysis leaves no doubt."

I stared hard at the blob of light. "Can we get better resolution? You can't tell what it is from this image."

Before Riza could reply from the comm console, Duchamp snapped, "We've amplified it as much as we can. That's the best we can get."

Rodriguez said, "It's within the footprint that your brother's craft would be expected to have, knowing what we know about when and where he went down. Nothing else metallic has shown up in the region."

"We'll have to go lower for better resolution," Duchamp said. "Get under the cloud deck and use the telescopes."

"What region is that?" Marguerite asked, from behind me.

"Aphrodite," said her mother.

"It's a highland region, more than two kilometers higher than the surrounding plains," Rodriguez said.

"Then it must be cooler," I said.

Duchamp smiled humorlessly. "Cooler, yes. The ground temperature is down to a pleasant four hundred degrees Celsius."

The lowland surface temperature averages above four hundred fifty degrees, I knew.

"Are we set for atmosphere entry?" I asked.

"The heat shield's been checked out," Duchamp replied. "Propulsion is ready."

"And still no word from Fuchs?"

Riza answered from the comm console, "He entered the cloud deck two hours ago, halfway around the planet. I got his entry position from the IAA."

"Then he hasn't seen the wreckage?"

Duchamp shook her head. "If we've seen that glint, he has too."

"The plane of his entry was almost exactly equatorial," Riza said, almost apologetically. "He'll most likely come out of the clouds in the same region as the glint."

I felt a dull throb in my jaw and realized that my teeth were clenched tight. "Very well then," I said. "We'd better get under the clouds, too."

Duchamp nodded, then touched a stud on her chair's left armrest. "Captain to crew: take your entry stations. Stand by for atmospheric entry in ten minutes." She lifted her hand and looked directly at me. "Clear the bridge of all nonessential personnel."

I took her unsubtle hint and backed out into the passageway. Marguerite was already striding away.

"Where are you going?" I called after her.

"To my lab. I want to record the entry."

"The automatic sensors—"

"They're not programmed to look for organic molecules or other exotic species. Besides, I want to get the entry process on video. It'll look good for your news report."

I started to reply, then sensed Rodriguez standing behind me.

"She threw you off the bridge, too?"

He grinned at me. "My entry station is up forward with the life-support technician." He squeezed past me and started along the passageway.

The trouble was, I had no official entry station. If we went strictly by the rules I should've slid into my berth and stayed strapped in there until we jettisoned the heat shield. But I had no intention of doing that.

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"Is there room for a third person up there?" I asked, trailing after Rodriguez.

"If you don't mind the body odors," he said over his shoulder.

"I showered this morning," I said, hurrying to catch up with him.

"Yeah, well, it's gonna get a little warm up there, you know. You'd be more comfortable in your berth."

I lifted my chin a notch. "You don't have to pamper me."

Rodriguez glanced over his shoulder at me. "Okay, you're the boss. You wanta be in the hot seat, come on along."

Striding down the passageway behind him, I asked, "How are you and Duchamp getting along?"

"Fine," he said, without slowing down or looking back toward me. "No problems."

Something in his voice sounded odd to me. "Are you sure?"

"We've worked things out. We're okay."

He sounded strange . . . cheerful, almost. As if he was in on a joke and I wasn't.

We passed Marguerite's tiny lab. The accordion-pleat door was folded open and I could see her standing in the cubicle, her head bent over a palm-sized video camera.

"You'll have to strap down for the entry," Rodriguez told her. "It's gonna get bumpy for a while."

"I'll help her," I said. "You go ahead and I'll catch up with you." Mr. Gallant, that's me.

Rodriguez looked uncertain for a moment, but then he nodded acceptance. "The two of you have got to be belted in for the entry. I don't care where, but you've got to be in safety harnesses. Understood?"

"Understood," I assured him. Duchamp had made us practice the entry procedures at least once a day for the past two weeks.

"ENTRY BEGINS IN EIGHT MINUTES," the countdown computer announced.

Marguerite looked up from her work. "There. The vidcam's ready."

She pushed past me and started down the passageway to the observation blister, the camera in her hand.

"Aren't you going with Tom?" she asked.

"I was," I said, "but if you don't mind I'd rather stay with you."

"I don't mind."

"Rodriguez gave me the feeling I'd just be in his way up there."

"I'm sure he didn't mean it that way."

"I know when I'm being condescended to," I insisted.

"Tom's not like that."

We reached the blister, a metal bubble that extended outward from the gondola's main body. Three small observation ports studded its side, each window made of thick tinted quartz. Four padded swivel chairs were firmly bolted to the deck.

"You won't see much through the tinting," I said.

Marguerite smiled at me, and went to a small panel beneath the port that slanted forward. Opening it, she snapped her camera into the recess. Then she shut the panel again. Three tiny lights winked on: two green, one amber. As I watched, the amber light turned red.

"What's that?" I asked, puzzled. "I thought I knew every square centimeter of this bucket."

"God is in the details," Marguerite said. "I got Tom and my mother to allow me to build this special niche here. It's like an airlock, with an inner hatch and an outer one."

"They allowed you to break the hull's integrity?" I felt shocked.

"It was all done within the standard operating procedures. Tom and Aki both checked it out."

Akira Sakamoto was our life-support technician: young, chubby, introspective to the point of surliness, so quiet he was almost invisible aboard the ship.

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I was still stunned. "And the camera's exposed to vacuum?"

She nodded, obviously pleased with herself. "The outer hatch opened when the inner one sealed. That's why the third light is red."

"Why didn't anybody tell me about this?" I wasn't angry, really. Just surprised that they'd do this without at least telling me.

"It was in the daily logs. Didn't you see them?" Marguerite turned the nearest swivel chair to face the port and sat in it.

I took the chair next to her. "Who reads the daily reports? They're usually nothing but boring details."

"Tom highlighted it."

"When? When was this done?"

She thought a moment. "The second week out. No, it was the beginning of the third week." With an impatient shake of her head, she said, "Whenever it was, you can look it up in the log if you want the exact date."

I stared at her. She was smiling impishly. She was enjoying this.

"I'll fry Rodriguez's butt for this," I muttered. It was a phrase I had often heard my father growl. I never thought I'd say it myself.

"Don't blame Tom!" Marguerite was suddenly distraught, concerned. "My mother okayed it. Tom was only doing what I asked and the captain approved."

"ENTRY IN SIX MINUTES," came the automated announcement.

"So you asked, your mother approved, and Rodriguez did the work without telling me."

"It's only a minor modification."

"He should have told me," I insisted. "Breaching the hull is not minor. He should have pointed it out to me specifically."

Her roguish smile returned. "Don't take it so seriously. If Tom and my mother okayed it, there's nothing to worry about."

I knew she was right. But dammit, Rodriguez should have informed me. I'm the owner of this vessel. He should have made certain that I knew and approved.

Marguerite leaned over toward me and tapped a forefinger against my chin. "Lighten up, Van. Enjoy the ride."

I looked into her eyes. They were shining like polished onyx. Suddenly I leaned toward her and, reaching a hand behind the nape of her neck, I pulled her to me and kissed her firmly on the lips.

She pushed away, her eyes flashing now, startled, almost angry.

"Now wait a minute," she said.

I slid back in my chair. "I . . . you're awfully attractive, you know."

She glared at me. "Just because my mother's letting Tom sleep with her is no reason for you to think you can get me into your bed."

I felt as if someone had whacked me with a hammer. "What? What did you say?"

"You heard me."

"Rodriguez and your mother?"

The indignation in her eyes cooled a bit. "You mean you didn't know about them?"

"No!"

"They're sleeping together. I thought everyone on board knew it."

"I didn't!" My voice sounded like a little boy's squeak, even to myself.

Marguerite nodded, and I saw in her expression some of the bitterness her mother exuded constantly.

"Ever since we left Earth orbit. It's my mother's way of solving personnel problems."

"ENTRY IN FIVE MINUTES."

"We'd better strap in," Marguerite said.

"Wait," I said. "You're telling me that your mother is sleeping with Rodriguez to smooth over the fact that she's captain and he's only second-in-command?"

Marguerite did not reply. She concentrated on buckling the seat harness over her shoulders.

"Well?" I demanded. "Is that what you're saying?"

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"I shouldn't have mentioned it," she said. "I've shocked you."

"I'm not shocked!"

She looked at me for a long moment, her expression unfathomable. At last she said, "No, I can see that you're not shocked."

"I'm accustomed to men and women enjoying sex together," I told her.

"Yes, of course you are."

Then a new thought struck me. "You're angry at your mother, is that it?"

"I'm not angry. I'm not shocked. I'm not even surprised. The only thing that amazes me is that you can live in this crowded little sardine can for week after week and not have the faintest inkling of what's going on."

I had to admit to myself that she was right. I'd been like a sleepwalker. Or rather, like a clown. Going through the motions of being the owner, the man in charge. All these things happening and I hadn't the slightest clue.

I sagged back in my padded chair, feeling numb and stupid. I started fumbling with my safety harness; my fingers felt thick, clumsy. I couldn't take my eyes off Marguerite, wondering, wondering.

She looked back at me, straight into my eyes. "I'm not like my mother, Van. I may be her clone, but I'm nothing like her. Don't ever forget that."

"ENTRY IN FOUR MINUTES."

Orbiting Venus' hot, thick atmosphere at slightly more than seven kilometers per second, *Hesperos* fired its retrorockets at precisely the millisecond called for in the entry program.

Strapped into the chair in the observation blister, I felt the ship flinch, like a speeding car when the driver taps the brake slightly.

I leaned forward as far as the safety harness would allow. Through the forward-angled port I could see the rim of the big heat shield and, beyond it, the smooth saffron clouds that completely shrouded the planet.

Except the clouds were no longer smooth. There were rifts here and there, long streamers floating above the main cloud deck, patterns of billows like waves rolling across a deep, deep sea.

Marguerite was turned toward the port also, so I could not see her full face, only a three-quarter profile. She seemed intent, her hands gripping the arms of her chair. Not white-knuckled, not frightened, but certainly not relaxed, either.

Me, I was clutching the arms of my chair so hard my nails were going to leave permanent indentations in the plastic. Was I frightened? I don't know. I was excited, taut as the Buckyball cable that had connected us to the old *Truax*. I was breathing hard, I remember, but I don't recall any snakes twisting in my gut.

Something bright flared across the rim of the heat shield and I suddenly wished I were up on the bridge, where I could see the instruments and understand what was happening. There was an empty chair up there; I should have demanded that I sit in it through the entry flight.

The ship shuddered. Not violently, but enough to notice. More than enough. The entire rim of the heat shield was glowing now and streamers of hot gas flashed past. The ride started to get bumpy.

"Approaching maximum *g* forces," Duchamp's voice called out over the intercom speaker in the overhead.

"Max *g*, check," Rodriguez replied, from his position up in the nose.

It was *really* bumpy now. I was being rattled back and forth in my chair, happy to have the harness holding me firmly.

"Maximum aerodynamic pressure," Duchamp said.

"Temperature in the forward section exceeding max calculated." Rodriguez's voice was calm, but his words sent a current of electricity through me.

The calculations have an enormous safety factor in them, I tried to reassure

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myself. It would have been easier if the ship didn't feel as if it were trying to shake itself apart.

I couldn't see a thing through the port now. Just a solid sheet of blazing hot gases, like looking into a furnace. I squeezed my eyes down to slits while the battering, rattling ride went on. My vision blurred. I closed my eyes entirely for a moment. When I opened them cautiously, I could see fairly well again, although the ship was still shuddering violently.

Marguerite hadn't moved since the entry began, she was still staring fixedly ahead. I wondered if her camera was getting anything or if the incandescent heat of our entry into the atmosphere had fried its lens.

The ride began to smooth out a bit. It was still bumpier than anything I had ever experienced before, but at least now I could lean my head back against the padded headrest and not have it bounce so hard it felt like I was being pummelled by a karate champion.

Marguerite turned slightly and smiled at me. A pale smile, I thought, but it made me smile back at her.

"Nothing to it," I said, trying to sound brave. It came out more like a whimper.

"I think the worst is over," she said.

Just then there was an enormous jolt and an explosion that would have made me leap out of my chair if I weren't strapped in. It took just a flash of a second to realize that it was the explosive bolts jettisoning the heat shield, but in that flash of a second I must have pumped my entire lifetime's supply of adrenaline into my blood. I came very close to wetting myself; my bladder felt painfully full.

"We're going into the clouds!" Marguerite said happily.

"Deceleration on the tick," Duchamp's voice rang out.

"Heat shield jettison complete," Rodriguez replied. "Now we're a blimp."

Rodriguez was inaccurate, I knew. A blimp has a soft envelope; ours was rigid cermet. It wasn't often I could catch Rodriguez in a slip of the tongue. I threw a superior smile to Marguerite as I popped the latch on my safety harness. The instant I stood up, though, *Hesperos* shuddered, lurched, swung around crazily and accelerated so hard I was slammed right back into my chair.

The superrotation.

The solid body of the planet may turn very slowly, but Venus' upper atmosphere, blast-heated by the Sun, develops winds of two hundred kilometers per hour and more that rush around the entire planet in a few days. In a way, they're like the jet streams on Earth, only bigger and more powerful.

Our lighter-than-air vessel was in the grip of those winds, zooming along like a leaf caught in a hurricane. We used the engines hanging outside the gondola only to keep us from swinging too violently, otherwise we would have depleted our fuel in a matter of hours. We couldn't fight those winds, we could only surf along on them and try to keep the ride reasonably smooth.

Truax, up in a safe, stable orbit, was supposed to keep track of our position by monitoring our telemeter beacon. This was for two reasons: to stay in constant communications contact with us and to plot the direction and speed of the superrotation wind, with *Hesperos* playing the same role as a smoke particle in a wind tunnel. But *Truax* hadn't deployed the full set of communications satellites around the planet by the time we got caught in the superrotation. Without the commsats to relay our beacon, they lost almost half our first day's data.

And if anything had gone wrong, they wouldn't know it for ten to twelve hours.

Fortunately, the only trouble we had was a few bruised shins as *Hesperos* lurched and swirled in the turbulent winds. It was like being in a racing yacht during a storm: you had to hold on to

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something whenever you moved from one place to another.

It was scary at first, I admit. No amount of lectures, videos or even VR simulations can really prepare you for the genuine experience. But in a few hours I got accustomed to it. More or less.

I spent most of those hours right there in the observation blister, staring out as we darted along the cloud tops. Marguerite got up and went back to her lab; crew members passed by now and then, stumbling and staggering along the passageway, muttering curses every time the ship pitched and they banged against a bulkhead.

At one point Marguerite came back to the blister, a heavy-looking gray box of equipment in her hands.

"Shouldn't you be checking the sensors up forward?" she asked, a little testily, I thought.

"They're running fine," I said. "If there were any problems I'd get a screech on my phone." I tapped the communicator in the chest pocket of my coveralls.

"Don't you want to see the data they're taking in?"

"Later on, when the ride settles down a little," I said. It had always nonplussed me that many scientists get so torqued up about their work that they have to watch their instruments while the observation is in progress. As if their being there can make any difference in what the instruments are recording.

Marguerite left and I was alone again, watching the upper layer of the cloud deck reaching for us. Long, lazy tendrils of yellowish fog seemed to stretch out toward us, then evaporate before my eyes. The cloud tops were dynamic, bubbling like a boiling pot, heaving and breathing like a thing alive.

Don't be an anthropomorphic ass, I warned myself sternly. Leave the similes to the poets and romantics like Marguerite. You're supposed to be a scientist.

Of sorts, a sardonic inner voice scoffed. You're only playing at being a scientist. A real scientist would be watching his sensors and data readouts like a tiger stalking a deer.

And miss this view? I answered myself.

We were dipping into the clouds now, sinking down into them like a submarine sliding beneath the surface of the sea. Yellow-gray clouds slid past my view, then we were in the clear again, then more mountains of haze covered the port. Deeper and deeper we sank, into the sulfuric-acid perpetual global clouds of Venus.

The ride did indeed smooth out, but only a little. Or maybe we all became accustomed to the pitching and rolling. We got our sea legs. Our Venus legs.

It was eerie, sailing in that all-enveloping fog. For days on end I stared out of the ports and saw nothing but a gray sameness. I wanted to push ahead, to go deeper, get beneath the clouds so we could begin searching the surface with telescopes for the wreckage of my brother's vessel.

But the mission plan called for caution, and despite my eagerness I understood that the plan should be followed. We were in uncharted territory now, and we had to make certain that all of *Hesperos'* systems were performing as designed.

The mammoth cermet envelope above us had been filled (if that's the right word) with vacuum. Its hatches had been open to vacuum all the time of our flight from Earth orbit, then sealed tight when we entered Venus' atmosphere. What better flotation medium for a lighter-than-air vessel than nothingness?

Now we were slowly filling the envelope with hydrogen gas, sucked out of the clouds' abundant sulfuric acid through our equipment that separated out the wanted hydrogen and released the unwanted sulfur and oxygen. On Earth hydrogen's flammability would have been dangerous, but Venus' atmo-

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sphere contained practically no free oxygen, so there was no danger of explosion or fire. The envelope itself was a rigid shell of cermet, a ceramic-metal composite that combined toughness and rigidity yet was lighter than any possible metal alloy.

To go deeper, we would vent hydrogen overboard and replace it with atmospheric gas: mainly carbon dioxide. When the time came to rise again, we intended to break down the carbon dioxide into its component elements of carbon and oxygen, vent the carbon overboard and let the lighter oxygen buoy us upward. Higher up we intended to dissociate the sulfuric acid molecules of the clouds again and refill the envelope with hydrogen.

We had tested the equipment for splitting the carbon dioxide and sulfuric acid molecules before we ever took off from Earth, and now, inside the globe-girdling cloud deck of Venus, we put it to work to fill the gas envelope with hydrogen.

Eager as I was to go deeper, I was perfectly happy to see that the equipment worked in Venus' clouds. I had no desire to be stuck down at the surface with no way to come back up.

So we coasted along in the uppermost cloud deck, patiently filling the big shell above us and testing our equipment. Once in a while it seemed to me that we weren't moving at all, that we were stuck in place like a ship run aground on a reef. All we could see out the ports was that perpetual yellowish-gray sameness. But then some strong current in the atmosphere would grab us and the gondola would tilt and groan like a creaking old sailing ship and my insides would flutter just a little bit.

I was constantly worried about Fuchs, of course, but the IAA reports on his activity showed that he was also moving cautiously. He had entered the atmosphere several hours before we did, but so far had not gone much deeper than we had. Like us, he was floating in the upper reaches of the top cloud deck, pushed around the planet by the superrotation winds.

"He's no fool," Duchamp told me as we sat together in the spartan little galley. "Lars takes risks, but only when he's certain the odds are in his favor."

"You know him?" I asked.

She made a thin smile. "Oh, yes. Lars and I are old friends."

"Friends?" I felt my brows hike up.

Her smile faded. "I first met him just after he had lost his business and his wife. He was a pretty desperate man then. Hurt and angry. Bewildered. Everything he had built up in his life had been snatched away from him." She exhaled a puff of air through her nostrils, something between a grunt and a sigh.

The expression on her face told me she knew perfectly well that the man who had destroyed his company and taken his wife was my father. She didn't have to say it; we both knew.

"But he pulled himself up again, didn't he?" I snapped. "He's done fairly well in asteroid mining, hasn't he?"

Duchamp looked at me for a long silent moment, the kind of look a university professor gives to an especially dense and hopeless student.

"Yes," she said. "Hasn't he."

At least, during those first days coasting through the clouds, I had an excuse to stay close to Marguerite. I was supposed to be a planetary scientist, I kept reminding myself, and even though she was a biologist we began to work together, sampling the clouds.

Marguerite's lab was too crowded for both of us to use it at the same time, and it would have been impossible for us to work together in either her quarters or mine: each of us had nothing more than a narrow berth with a privacy screen shuttering it. We could have both fit in either berth, but no scientific research would have been done. Indeed, I found myself wondering what it would be like to have Marguerite cupped beside me in my berth. Or hers.

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But she had no romantic interest in me, that was clear. Instead, we turned the observation post up in the gondola's nose into a makeshift laboratory where we took samples of the cloud droplets and analyzed them.

"There really is water in the clouds!" Marguerite exclaimed happily, after a long day of checking and rechecking the results of our spectral analyses.

"Thirty parts per million," I grumbled. "It might as well be zero for all the good—"

"No, no, you don't understand," she said. "Water means life! Where water exists, life exists."

She was really excited. I was more-or-less playing at being a planetary scientist but to Marguerite the search for life was as thrilling and absorbing as Michelangelo's drive to create great works of art out of rough slabs of marble.

We were sitting cross-legged on the metal decking up in the gondola's nose section because there was no room for chairs and nobody had thought to bring any cushions aboard. The transparent quartzite nose itself showed only the featureless yellowish-gray of the eternal cloud deck: it might just have well been spray-painted that color for all that we could see out there. Two mass spectrometers sat to one side of us, half a dozen hand-sized computers were scattered on the deck plates, and a whole rack of equipment boxes—some gray, some black—hummed away along the bulkhead beside me.

"The presence of water," I pointed out, "does not automatically mean the presence of life. There is a good deal of water on the Moon, but no life there."

"Humans live on the Moon," she countered, with mischief in the lilt of her voice.

"I mean native lunar life, you know that."

"But the water deposits on the Moon are frozen. Wherever there's *liquid* water, like under the ice crust on Europa—"

"The water vapor in these clouds," I interrupted, jabbing a finger toward the observation port, "hardly constitute a supply of liquid water."

"They do to microscopic organisms."

I had to hold back a laugh. "Have you found any?"

Her enthusiasm didn't waver one iota. "Not yet. But we will!"

I could only shake my head in admiration for her perseverance.

"This proves that there must be at least some volcanic activity down at the surface," Marguerite said.

"I suppose so," I agreed.

The reasoning was simple enough: Any water vapor in Venus' atmosphere quickly boiled up to the top of the clouds, where the intense ultraviolet radiation from sunlight broke up the water molecules into hydrogen and oxygen, which eventually evaporated away into space. So there had to be a fresh supply of water constantly replenishing the droplets. Otherwise they would have all been dissociated and boiled off the planet ages ago. The source of the water most likely came from the planet's deep interior and was vented into the atmosphere by volcanic eruptions.

On Earth volcanoes constantly blow out steam, sometimes in explosions that tear the tops off the mountains. But the water vapor they vent into the atmosphere stays in the atmosphere, on Earth. It's not lost to space because Earth's atmosphere gets cold at high altitudes and the water condenses and falls back as rain or snow. That's why Earth has oceans and Venus doesn't. Earth's upper atmosphere is a "cold trap" that prevents the water from escaping the planet. Hothouse Venus doesn't have a cold trap in its upper atmosphere: at the altitude where on Earth the temperature dips below freezing, Venus' is almost four hundred degrees Celsius, four times hotter than water's boiling point. As a result Venus can't build up any appreciable water content in its atmosphere.

"We'll have to go deeper to find lifeforms in the clouds," Marguerite said, as

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much to herself as to me. "The UV absorber isn't that much further down."

Fuchs still worried me. Apparently he was still sailing in the clouds, as we were. But aside from his position I could get no information about him from the IAA. For a good reason: he was giving out no information, nothing but his tracking beacon and the standard telemetering data that showed his basic systems to be operating in good order. When I tried to get details about the design of his ship or the array of sensing systems he carried, I drew a blank. *Lucifer* was his ship, his design, built out in the deep darkness of the Asteroid Belt, equipped according to his specifications and no one else's. He reported the minimum required by the IAA and kept everything else to himself.

One thing I was able to do during those first days in the clouds was to begin to build up a map of the superrotation wind pattern. By recording our position from the ship's inertial navigation system I was able to generate a three-dimensional plot of where those winds blew, a sort of weather map of Venus' jet streams. Every time a powerful gust buffeted us and made me grab for a handhold, every time a sudden upwelling bounced us or a cold spot made us drop until my stomach crawled up into my throat, I thought to myself that at least I was getting useful data.

The winds fanned outward from the subsolar point, of course. That was where the Sun was directly overhead, blazing down on the planet's atmosphere like a blowtorch. Venus turns so slowly, once in 243 Earth days, that the subsolar spot gets blasted remorselessly. The atmosphere rushes away from there in a gigantic heat-driven flow, setting up currents and convection cells that span the girth of the planet. I measured wind speeds of nearly four hundred kilometers per hour: we were setting a Guinness speed record for lighter-than-air vessels.

Deeper down, where the atmosphere gets thicker and so much hotter, the winds die to almost nothing. At a pressure similar to that of an Earthly ocean a kilometer or so deep, there could be nothing that we would recognize as winds, only sluggish tidal motions.

At least, that's how the theory went.

My map of the superrotation winds was coming along quite nicely after a few days, and it made me proud to realize that I was making a real contribution toward understanding Venus. When I tried to extend my data down to a slightly lower altitude, though, in an effort to see how far down the winds might extend, the computer program glitched on me. Insufficient data, I thought, peering at the display screen.

I had coded the map with false colors, each color indicating a range of speeds. There they were, a network of jet streams all rushing out from the subsolar point, in shades of blue and green. With my VR goggles on, I saw it all in three-dimensional motion. But there was the damned glitch, a swath of red a few kilometers below our present altitude. Red should have indicated even higher wind velocity than we were in now, but I knew that was wrong. The wind velocities had to get lower as we went down in altitude, not higher. Something was wrong with the program.

I mentioned it to Duchamp and Rodriguez when we met to decide on when we would start down toward the surface.

Our conference center was the observation blister, the only place in our cramped gondola where three or four people could sit comfortably. Duchamp and I sat side by side, our chairs swivelled away from the observation ports. Rodriguez sat on the floor facing us, his back against the far bulkhead.

"All systems have performed well within their design range," Duchamp said, tapping a manicured fingernail on the screen of her handheld computer. "Unless I hear otherwise, I declare this phase of the mission completed."

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Rodriguez nodded. "No complaints about that. It'll be good to get out of this wind and down to a calmer altitude."

"Calmer," Duchamp said, "but hotter."

"We can handle the heat."

She smiled at him as if they had some private joke going between them.

I spoke up. "My map of the wind system keeps throwing this glitch at me." I had brought a handheld, too, and showed it to them.

"The red indicates even higher wind velocities than we're in now," I said.

"That's an extrapolation, isn't it?" Rodriguez asked. "It's not based on observational data."

"No, we haven't gone down that far, so we don't have any data from that altitude."

"A computer extrapolation," Duchamp said, like an art critic sniffing at some child's lopsided attempt to draw a tree.

"But the extrapolation is based on pretty firm meteorological data," I pointed out.

"Terrestrial meteorological data?" asked Duchamp.

I nodded. "Modified to take into account Venus' different temperature, pressure, and chemical regime."

"An abstraction of an abstraction," Duchamp said, with a *that's-that* wave of her hand.

Rodriguez was staring at the smear of red at the bottom of my map. He handed the palm-sized computer back to me and said thoughtfully, "You don't think there could be some kind of wind shear down at that altitude, do you?"

"A supersonic wind shear?" Duchamp scoffed.

"It's not supersonic at that pressure," Rodriguez pointed out.

She shook her head. "All the planetary physicists agree that the superrotation winds die out as you go deeper into the atmosphere and the pressure builds up. The winds get swamped by the increased pressure."

Rodriguez nodded thoughtfully, then said slowly, "Yeah, I know, but if there really is a wind shear it could be a killer."

Duchamp took a breath, glanced from him to me and back again, then made her decision.

"Very well," she said. "We'll rig for intense wind shear. Check out all systems. Make everything secure and tightened down, just as we did for atmospheric entry." She turned to me. "Will that satisfy you, Mr. Humphries?"

I was surprised at the venom in her reaction. I swallowed once and said, "You're the captain."

"Good." To Rodriguez she said, "Tommy, this means you'll have to go outside and manually check all the connectors and fittings."

He nodded glumly. "Yeah. Right."

Then, smiling coldly, Duchamp turned back to me. "Mr. Humphries, would you care to assist Tom?"

"Me?" I squeaked.

"We could use the extra hand," she said smoothly, "and the inspection is actually at your behest, isn't it? You and your computer program."

You bitch, I thought. Just because my computer program showed a possible problem she's blaming me for it. Now I've either got to risk my neck or show everybody that I'm a coward.

Rodriguez leaned across the narrow passageway separating us and grabbed my knee in a rough, friendly way.

"Come on, Mr. Humphries, it won't be so bad. I'll be with you every step of the way and you'll be able to tell your grandchildren about it."

If I live long enough to have grandchildren, I thought. But I swallowed my fear and said as calmly as I could, "Sure. It ought to be exciting."

It certainly was.

Basically, our task was to check all the connectors that held the gondola to the gas envelope above us. It was a job that a plumber could do, it didn't call for any special training. But we'd be outside, in a cloud of sulfuric acid droplets that was

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nearly a hundred degrees Celsius, more than fifty kilometers above the ground.

Rodriguez spent two intense hours briefing me in the virtual reality simulator on what we had to do. Six main struts had to be checked out, and six secondary ones. They connected the gondola to the gas shell; if they failed under stress we would go plunging down to the red-hot surface like an iron anvil.

Akira Sakamoto, our dour life support technician, personally helped me into my spacesuit. It was the same one I had used when we transferred from *Truax*, but now its exterior had been sprayed with a special heat-resistant ceramic. The suit seemed stiffer to me than before, although Sakamoto insisted the ceramic in no way interfered with limb motion.

Without a word, without any discernable expression on his chunky broad face, he slipped the safety harness around my waist and clicked it in place, then made certain both its tethers were properly looped so they wouldn't trip me as I tried to walk.

Dr. Waller helped to check out Rodriguez, who got into his suit unassisted. But you had to have somebody go around to make certain all the seals were okay and the electrical lines and life-support hoses hooked up properly from the backpack.

Marguerite came down to the airlock, too, and watched in silence as we suited up. I was trembling slightly as I wriggled into the ungainly suit, which was now sort of silvery from its new ceramic coating. But I realized with some surprise that my trembling wasn't so much fear as excitement. I knew I should have been scared out of my bleeding wits, but somehow I wasn't. I was going to *do* something, something that had to be done, and even though it was dangerous I found myself actually looking forward to it.

In the back of my mind, a jeering voice was saying, Famous last words. How many fools have looked forward to the adventure that killed them.

But with Marguerite watching me I didn't seem to care. I thought I saw a hint of admiration in her eyes. At least, I hoped it was admiration and not amusement at the foolish machismo I was exhibiting.

"Okay, we do it just the way we did in the sim." In my helmet earphones, Rodriguez's voice sounded harsh and tight, definitely more tense than his usual easy-going attitude.

I nodded, then realized he couldn't see me through the tinted fishbowl helmet, so I said, "Roger." Just like a real astronaut, I thought.

He went into the airlock ahead of me, cycled it down and then went outside. Once the outer airlock hatch closed again and the 'lock refilled with ship's air, the inner hatch indicator light turned green.

My spacesuit was definitely stiff. Even with the servomotors at my elbow and shoulder joints grinding away, it took a real effort to move my arms. As the airlock cycled down and the outer hatch slid open, I had to remind myself that this was going to be different from an EVA in space. This would be more like doing steelwork at the top of a tremendously tall skyscraper. If I made a false step I wouldn't simply float away from the ship, I'd plunge screaming to the ground, fifty kilometers below.

"Take it slow and easy," Rodriguez told me. "I'm right here. Hand me your tether before you step out."

I could see his spacesuited form clinging to the handgrips set into the gondola's outer hull, beside the hatch. Both his tethers were clipped to its rungs.

I handed him one end of my right-hand tether. He clipped it a rung beside his own.

"Okay now, just the way we did in the sim. Come on out."

The good thing was we were enveloped in the cloud, so I didn't have to

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worry about looking down. There was nothing to see out there except a blank yellow-gray limbo. But I could feel the ship shuddering and pitching in the currents of wind.

"Just like rock climbing," Rodriguez said, with an exaggerated heartiness. "Piece of cake."

"When did you do any rock climbing?" I asked as I planted one booted foot on a rung of the ladder.

"Me? Are you kidding? When I get up more than fifty meters I want an airplane surrounding me."

I had never gone rock climbing, either. Risking one's neck for the fun of it has always seemed the height of idiocy to me.

But this was different, I told myself. There was a job to be done. I was making a real contribution to the mission now, not just cowering in my bunk while others did the work.

Still, it was scary. I suppose Rodriguez could've done it all by himself, but long decades of experience dictated that it was far safer to have two people go out together, even if one of them was a neophyte. Besides, with me out there we could cut the time for the inspection almost in half; that in itself made the whole job a lot safer.

In a way, the pressure of the Venusian atmosphere helped us. In space, with nothing outside a spacesuit's fabric but vacuum, a spacesuit tends to balloon up and get stiff. That's why we had the miniature servomotors on the suits' joints and gloves, to assist our muscles in bending and flexing. Even at this high altitude, though, the atmospheric pressure was enough to make it almost easy to move around in the suits. Even the gloves flexed fairly easily; the servomotors of the spiny exoskeleton on the backs of the gloves hardly had to exert themselves at all.

One by one, Rodriguez and I checked the braces and struts that held the gondola to the gas envelope. All the welds seemed solid, to my eyes. Neither of us could find any sign of damage or deterioration. One of the hoses that fed hydrogen from the separator to the envelope seemed a bit looser than Rodriguez liked; he worked on it for several minutes with a wrench from the tools clipped to his harness, dangling from a support strut like a monkey in a banana tree.

As I watched Rodriguez working, I checked the thermometer on the wrist of my suit. To my surprise it read only a few degrees above freezing. Then I remembered that we were still fifty-some kilometers above the ground; on Earth we'd be high above the stratosphere, on the fringe of outer space. Here on Venus we were in the middle of a thick cloud of sulfuric acid droplets. Not too far below us, the atmosphere heated up quickly to several hundred degrees.

Dangling out there in the open reminded me of something but I couldn't put my finger on it until at last I remembered watching a video years ago, when I'd been just a child, about people hanggliding off some seaside cliffs in Hawaii. I had burned with jealousy then, watching them having so much fun while I was stuck in a house almost all the time, too frail to try such an adventure. And too scared, I've got to admit. But here I was, on another world, racing in the wind fifty klicks high!

"That's done," Rodriguez said as he returned the wrench to its place on his belt. But he fumbled it and the wrench dropped out of sight. One instant it was in his hand, then, "Oops!" and it was gone. I realized that's what would happen to me if my tethers failed.

"Is that it?" I asked. "Are we done?"

"I ought to check the envelope for any signs of ablation from the entry heat," Rodriguez said. "You can go back inside."

Without even thinking about it I replied, "No, I'll go with you."

So we clambered slowly up the rungs set into the massive curving bulk of the gas envelope, with that wind gushing past us. I knew the atmospheric pres-

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sure was too thin up at this altitude to really push us, yet I felt as if I was being nudged, harried, shaken by the wind.

It was slow going, climbing one rung, unclipping one tether and snapping it on a higher rung, then stepping up again and unclipping the other tether. Just like mountain climbers, we never moved a step until we had both tethers locked on safely. I could hear Rodriguez's breathing in my earphones, puffing hard with each step he took.

Duchamp was listening in on everything, of course. But I knew that if we got into trouble there was nothing she or anyone else could do about it in time. It was just Rodriguez and me out here, on our own. It was frightening and kind of exhilarating at the same time.

At last we got to the long catwalk that ran along the top of the envelope. Rodriguez knelt down and activated the switch that raised the flimsy-looking safety rail which ran the length of the metal mesh walkway. Then we fastened our tethers to the rail; it stood waist-high all the way down the catwalk, from nose to tail. A row of cleats projected up from the edge of the walkway, like the bitts on a racing yacht where you tie down the lines from the sails.

"Top of the world," Rodriguez said cheerfully.

"Yeah," I said, my voice definitely shaky.

Together we walked to the bulbous nose of the envelope, where the big heat shield had been connected. I could see the stumps of the rods that had held the shield in place, blackened from the explosive bolts that had sheared them off. Rodriguez bent over and examined the nose region, muttering to himself like a physician thumping a patient's chest during a checkup. Then we walked slowly back toward the tail, him in the lead, our tethers sliding along the safety rail.

I saw it first.

"What's that discoloration?" I asked, pointing.

Rodriguez grunted, then took several steps toward the tail. "H'mm," he mumbled. "Looks like charring, doesn't it?"

I suddenly remembered that these clouds were made of sulfuric acid.

As if he could read my mind, Rodriguez said, "Can't be the sulfuric acid, it doesn't react with the cermet."

"Are you sure?" I asked.

He chuckled. "Don't worry about it. It can't even attack the fabric of your suit."

Very reassuring, I thought. But the charred stains on the cermet skin of the gas envelope were still there.

"Could it be from the entry heat?"

I could sense him nodding inside his helmet. "Some of the heated air must've flowed over the shield and singed the butt end of the envelope a little."

"The sensors didn't record a temperature spike there," I said.

"Might've been too small to notice. If we expand the graph we'll probably see it."

"Is it a problem?"

"Probably not," he said. "But we oughtta pressurize the envelope to make certain it doesn't leak."

I felt my heart sink. "How long will that take?"

He thought before answering. "The better part of a day, I guess."

"Another day lost."

"Worried about Fuchs?" he asked.

"Yes, of course."

"Well, he's likely got problems of his—*Hey!*"

The safety rail alongside Rodriguez suddenly broke away, a whole section of it flying off into the yellowy haze, taking one his tethers with it. He was yanked off his feet, flailing his arms and legs, the remaining tether anchoring him to the still-standing section of rail, the other one trying to pull him off the ship.

I lunged for him but he was already too far away for me to reach without taking off my own tethers.

"Pull me in!" he yelled, his voice bellowing in my earphones.

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"What's happened?" Duchamp asked sharply in my earphones.

I saw him unclip the one tether from his belt. It snapped off into the clouds. I grabbed the other and began hauling him in.

But the railing itself was wobbling, shaky. It was going to tear away in another few seconds, I realized.

"Pull me in!" Rodriguez shouted again.

"What's happening out there?" Duchamp demanded.

I unclipped one of my own tethers and fastened it onto one of the cleats set into the catwalk. Then, with Duchamp jabbering in my earphones, I unclipped Rodriguez's remaining tether before the railing broke off and he went sailing into oblivion.

"What the hell are you doing?" he yelled.

His sudden weight almost tore my arms out of their sockets. Squeezing my eyes shut, I saw stars exploding against the blackness. With gritted teeth, I clumped down onto my knees and used all my strength to clamp the end of his tether to the cleat next to mine.

I saw that the broken end of the railing was fluttering now, shaking loose. And my other tether was still hooked to it. Instead of trying to reach its end I simply unsnapped it from my belt and let it flap loose, then turned back to hauling in Rodriguez's line.

He was pulling himself in as hard as he could. It seemed like an hour, the two of us panting and snorting like a couple of tug-of-war contestants, but he finally planted his boots back on the catwalk. All this time Duchamp was yelling in my earphones, "What is it? What's going on out there?"

"We're okay," Rodriguez gasped at last, down on his hands and knees on the catwalk. For an absurd instant I thought he was going to pull off his helmet and kiss the metal decking.

"You saved my life, Van."

It was the first time he'd called me anything but "Mr. Humphries." It made me feel proud.

Before I could reply, Rodriguez went on, in a slightly sheepish tone, "At first I thought you were going to leave me and go back to the airlock."

I stared at the blank fishbowl of his helmet. "I wouldn't do that, Tom."

"I know," he said, still panting from his exertion and fear. "Now," he added.

Captain Duchamp and Dr. Waller were waiting for us when we came through the airlock. I could hear her demanding questions, muffled by my helmet, directed at Rodriguez.

"What happened out there? What was that about the safety rail?" And finally, "Are you all right?"

Rodriguez started to explain as I lifted my helmet off. Waller took it from my trembling hands and I saw Marguerite hurrying up the passageway toward us.

While we both worked our way out of the spacesuits, Rodriguez gave a clipped but thorough explanation of what had happened to us. Duchamp looked blazingly angry, as if somehow we had caused the trouble for ourselves. I kept glancing at Marguerite, standing behind her mother. So much alike, physically. So strikingly similar in the shape of their faces, the depth of their jet-black eyes, the same height, the same curves of their figures.

Yet where the captain was truculent and demanding, Marguerite looked troubled, distressed—and something else. Something more. I couldn't tell what it was in her eyes; I suppose I subconsciously hoped it was concern for me.

Duchamp and Rodriguez headed for the bridge, Waller went without a word back toward his cubbyhole of an infirmary, leaving Marguerite and me alone by the racks of empty spacesuits.

"Are you alright?" she asked me.

Nodding, I said, "Fine. I think." I held out my hand. "Look, I'm not even shaking any more."

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She laughed, a delightful sound. "You've earned a drink."

We went down to the galley, passing Waller's closet-sized infirmary. It was empty, making me wonder where the doctor might hide himself.

As we took cups of fruit juice and sat on the galley bench, I realized that I did indeed feel fine. Was it Churchill who said that coming through a brush with death concentrates the mind wonderfully?

Marguerite sat beside me and took a sip of juice. "You saved Tom's life," she said.

The look in her eyes wasn't adoring. Far from it. But there was a respect in them that I'd never seen before. It felt terrifically good.

Heroes are supposed to be modest, so I waggled my free hand and said merely, "I just reacted on instinct, I guess."

"Tom would have been killed if you hadn't."

"No, I don't think so. He—"

"He thinks so."

I shrugged. "He would've done the same for me."

She nodded and brought the cup to her lips, her eyes never leaving mine.

I had to say something, so I let my mouth work before my brain did. "Your mother doesn't seem to have a molecule of human kindness in her. I know she's the captain, but she was practically chewing Tom's guts out."

Marguerite almost smiled. "That's the way she reacts when she's frightened. She attacks."

"Frightened? Her? Of what?"

"Tom nearly got killed! Don't you think that scared her? She is human, you know, underneath the stainless steel."

"You mean she really cares about him?"

Her eyes flashed. "Do you think she's sleeping with him merely to keep him satisfied? She's not a whore, you know."

"I . . ." I realized that I had thought precisely that. For once in my life, I kept my mouth shut while I tried to figure out what I should say next.

The speaker in the ceiling blared, "MR. HUMPHRIES WANTED ON THE BRIDGE."

Saved by the call of duty, I thought.

I sat scrunched down on the metal deck plate of the bridge between Duchamp's command chair and Rodriguez's. Willa Yeats, our sensors specialist, was in the chair usually occupied by Riza, the communications tech.

The four of us were staring hard at the main display screen, which showed a graph of the heat load the ship had encountered during entry into the atmosphere.

"No blip," Yeats said, with an *I told you so* tone. She was on the chubby side, moon-faced and pale-skinned, with the kind of dirty blonde hair that some people charitably call "sandy."

"There was no sudden burst of heat during the entry flight," she said. "The heat shield performed as designed and the sensors show all heat loads well below maximum allowable levels."

Duchamp scowled at her. "Then what caused the charring on the envelope?"

"And weakened the safety railing?" Rodriguez added.

Yeats shrugged as if it weren't important to her. "I haven't the faintest idea. But it wasn't a pulse of heat, I can tell you that."

She had a very proprietary attitude about the ship's sensing systems. As far as she was concerned, if her sensors didn't show a problem, no problem existed.

Duchamp obviously felt otherwise. The captain looked past me toward Rodriguez. "I suppose we'll have to go out there again and see just what those charring marks are."

Rodriguez nodded glumly. "I suppose."

"I'll go with you," I said. Before either of them could object I added, with a pinch of bravado, "I'm an experienced hand at this, you know."

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Duchamp did not look amused, but Rodriguez chuckled and said, "Right. My EVA lifesaver."

"You don't have to do that," Yeats said, obviously disappointed at our obtuseness. "If you simply pressurize the envelope the sensors will tell us if there's a leak."

"And what if we rip the damned envelope wide open?" Duchamp snapped. "Where are we then?"

Yeats looked abashed. She didn't have to answer. We all knew where we'd be if the envelope cracked. There was the descent module, the bathysphere-like craft that was designed to double as an escape pod. But the thought of all eight of us crammed into that tiny iron ball and rocketing up into orbit was far from comforting.

"Inspect the charring," Duchamp said with finality. "Then we can pressurize the envelope."

"Maybe," Rodriguez added, morbidly.

Gripping the arms of their two chairs, I pulled myself up to my feet. "Very well then, we'd better—"

Marguerite burst into the bridge, nearly bowling me over.

"Life!" she exclaimed, her eyes wide and shining. "There are living organisms in the clouds! Microscopic but multicelled! They're alive, they live in the clouds . . ."

She was babbling so hard I thought she was close to hysteria. Her mother snapped her out of it with a single question.

"You're sure?"

Marguerite took a deep, gulping breath. "I'm positive. They're alive."

Rodriguez said, "I've gotta see this."

I took Marguerite's arm as gently as I could and maneuvered her out into the passageway. Otherwise there was no room on the bridge for Rodriguez to get up from his chair.

We trooped behind Marguerite to her cubbyhole of a lab. As we stopped there I realized Duchamp had also left the bridge to accompany us. We stared at the image from the miniaturized electron microscope displayed on the wall screen. I saw some watery-looking blobs flailing around slowly. They were obviously multi-celled; I could see smaller blobs and dividing walls pulsating inside them. Most of them had cilia fringing their outer edges, microscopic oars paddling away constantly. But weakly.

"They're dying in here," Marguerite said, almost mournfully. "It must be the temperature, or maybe the combination of temperature and pressure. It's just not working!"

Turning from the wall screen's image, I said to her, "By god, you were right."

"It's a major discovery," Rodriguez congratulated.

"Send this to the IAA at once," Duchamp commanded. "Imagery and every bit of data you have. Get priority for this."

"But I've only—"

"Do you want a Nobel Prize or not?" Duchamp snapped. "Get this data to IAA headquarters *this instant*. Don't wait for Fuchs to get in first."

Marguerite nodded with understanding. For the first time since she'd burst into the bridge she seemed to calm down, come back to reality.

"I'll get Riza to establish a direct link with Geneva," Duchamp went on. "You bang out a written statement, two or three lines will be enough to establish your priority. But do it *now*."

"Yes," Marguerite said, reaching for her laptop computer. "Right."

We left her there in her lab, bent over the computer keyboard. Duchamp headed back toward the bridge, Rodriguez and I went toward the airlock, where the spacesuits were stored.

"RIZA," we heard Duchamp's voice over the intercom speakers, "REPORT TO THE BRIDGE AT ONCE." She didn't have to repeat the command; there was no room for doubt or delay in the tone of her voice.

"Bugs in the clouds," Rodriguez said to me, over his shoulder. "Who would've thought you could find any-

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thing living in clouds of sulfuric acid?"

"Marguerite did," I answered. "She was certain she'd find living organisms."

"Really?"

I nodded to his back. I had just witnessed a great discovery. Duchamp was right, her daughter would get a special Nobel for this, just like the biologists who discovered the lichen on Mars.

She expected to find living organisms on Venus, I told myself again. Maybe that's the secret of making great discoveries: the stubborn insistence that there's something out there to be discovered, no matter what the others say. Chance favors the prepared mind. Who said that? Some scientist, I thought. Einstein, most likely. Or maybe Freud.

We commandeered Dr. Waller and Willa Yeats to help us into the spacesuits. Waller hummed quietly as I pulled on my leggings and boots, then wormed into the torso and pushed my arms through the sleeves. Two meters away, Willa chattered like a runaway audio machine as she watched Rodriguez get into his suit. They checked out our life-support backpacks and made certain all the lines and hoses were properly connected. Then we sealed our helmets.

Rodriguez stepped into the airlock first. I waited for the lock to cycle, my heart revving up until I thought Riza at the comm console on the bridge must be able to hear it through the suit radio. Relax! I commanded myself. You've been outside before. There's nothing to be scared of.

Right. The last time Rodriguez had nearly gotten himself knocked off the ship. I had no desire to go plummeting fifty-some kilometers down to the rock-hard surface of Venus.

The airlock hatch slid open again and Rodriguez stepped back among us.

"What's the matter?" I asked. "What's wrong?"

This close, with the ship's interior lighting shining through his bubble helmet, I could see the puzzled, troubled look on his face.

"Got a red light on my head-up." The suit's diagnostic system, which splashed its display onto the helmet's inner surface, showed something was not functioning properly.

"What is it?" I asked.

"Gimme a minute," he snapped back. Then, "Huh . . . it says there was a pressure leak in the suit. Seems okay now, though."

Dr. Waller grasped the situation before I did. "But it went red when you cycled the air out of the airlock?"

"Yeah. Right."

We spent the better part of an hour pumping up the pressure in Rodriguez's suit until it started to balloon. Sure enough, there was a leak in his left shoulder joint. The suit fabric had a resin compound that self-repaired minor leaks, but the joints were cermet covered with plastic.

"It looks frayed," Dr. Waller said, his voice brimming with curiosity. "No, more like it was singed with a flame or some source of heat."

"Damn!" Rodriguez grumbled. "Suit's supposed to be guaranteed."

I remembered the old joke about parachutes: If it doesn't work, bring it back and we'll give you a new one. It was a good thing the suit's diagnostics caught the leak in the airlock. Outside, it could have killed him.

So Rodriguez unfastened his helmet and wriggled out of his suit and put on one of the backup suits. We would have to repair his suit, I thought. We only carried four spares.

Finally he was ready and went through the airlock. No problems with the backup suit. I heard him call me in my helmet earphones, "Okay, Mr. Humphries. Come on through."

I went into the airlock and got that same old feeling of being locked into a coffin when the inner hatch slid shut. The lock cycled down—and a red warning light started blinking on my the curving face of my helmet, flashing into my eyes like a rocket's red glare.

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"Hey, I've got a problem, too," I yelled into my microphone.

The entire EVA excursion was a bust. Both our original suits were leaking and Duchamp decided to scratch the EVA until we could determine what the problem was.

I thought I knew.

"I don't know," Marguerite said, frowning with puzzlement. "It's too soon for me to tell."

Her voice was low, tired. The excitement of her discovery had worn off; now I was presenting her with its horrifying consequences.

We were walking down the passageway from her lab to the galley, where we could sit together in comfort. I was leading the way, for once.

"It can't be a coincidence," I said over my shoulder. "There's got to be a connection."

"That's not necessarily true," she objected.

We reached the galley and I punched the dispenser for a cold cup of juice, then handed it to her. After I got one for myself, I sat beside her on the bench.

"There are bugs out in the clouds," I said.

"Microscopic multicellular creatures, yes," she agreed.

"What do they eat?"

"I don't know! It's going to take some time to find out. I've spent most of the day jury-rigging a cooler for them to live in!"

"What's your best guess?" I demanded.

She ran a hand through her thick dark hair. "Sulfur oxides are the most abundant compounds in the cloud droplets. They must metabolize sulfur in some way."

"Sulfur? How can anything eat sulfur?"

Marguerite jabbed a forefinger at me. "There are bacteria on Earth that metabolize sulfur. I would have thought you'd known that."

I had to grin. "You'd be surprised at how much I don't know."

She smiled back.

I pulled my handheld computer from my pocket and punched up a list showing the composition of the fibers of our spacesuits. No sulfur.

"Would they eat any of these materials?" I asked, showing her the computer's tiny display.

Marguerite shrugged wearily. "It's too soon to know, Van. On Earth, organisms metabolize a wide range of elements and compounds. Humans need trace amounts of hundreds of different minerals . . ." She took a deep, sighing breath.

"It's got to be the bugs," I said, convinced despite the lack of evidence. "Nothing else could have eaten through the suits like that."

"What about the railing? That's made of metal, isn't it?"

I tapped on the handheld. "Cermet," I saw. "A ceramic and metal composite." Another few taps. "Contains beryllium, boron, calcium, carbon . . . several other elements."

"Maybe the organisms need trace elements the way we need vitamins," Marguerite suggested.

I went back to the list of suit materials and displayed it alongside the list of the safety rail's composition. Plenty of similarities, although only the cermet had any measurable amount of sulfur in it, and not much at that.

Then I realized that both suits had leaked at joints, not the self-repairing fabric. And the joints were made of cermet, covered with a thin sprayed-on layer of plastic.

"You've got to find out what they digest," I urged Marguerite. "It's vitally important!"

"I know," she said, rising to her feet. "I'll get on it right away."

I thought about the charring along the tail end of the gas envelope. "They might be chewing up the shell, too."

"I'll get on it!" she fairly shouted, then started up the passageway back to her lab. She looked as if she were fleeing from me.

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So I'm pushing her, I thought. But we've got to know. If those bugs are eating our spacesuits and the ship itself we've got to get out of here and fast.

I stood there for a dithering moment, not certain of what I should do next. What could I do, except prod other people to do the things that I can't do myself?

I decided to go up to the bridge, but halfway there I bumped into Yeats, who was hurrying down the passageway in the opposite direction.

"Anything new?" I asked.

"All bad," she said as she squirmed past me. Her body felt soft and actually pleasurable as she pressed by. I wondered how a man's gonads could assert themselves even when his brain was telling him he's in deep trouble.

"What is it?" I called after her.

"No time," she shouted back, hurrying even faster. I'd never before seen her move at anything more than a languid stroll.

Shaking my head, in exasperation as much as disbelief, I made my way to the bridge. Duchamp and Rodriguez were both there. Good, I thought.

"We can't pressurize the gas envelope until we can determine its structural integrity," Duchamp was saying, in the kind of stilted cadence that I knew was meant for the ship's log. "The leak rate is small at present, but growing steadily. If it's not stopped it will affect the ship's trim and cause an uncontrollable loss of altitude."

She looked up at me as I stopped in the open hatchway. Jabbing a finger on the chair arm's stud that turned off the recorder, she asked impatiently, "Well?"

"We've got to get out of these clouds," I said. "The bugs out there are eating the ship."

Duchamp arched her brows. "I don't have time for theories. We've developed a leak in the gas envelope. It's minor, but it's growing."

"The shell's leaking?" My voice must have gone up two octaves.

"It's not serious," Rodriguez said quickly.

I turned to him. "We've got to get out of these clouds! You were out there, Tom. The bugs—"

"I make the decisions here," Duchamp snapped.

"Now wait a minute," I said.

Before I could go further, she said, "With all deference to your position as owner of this vessel, Mr. Humphries, I am the captain and I will make the decisions. This isn't a debating society. We're not going to take a vote on the subject."

"We've got to get out of these clouds!" I insisted.

"I totally agree," she said. "As soon as we can repair the leak in the envelope, I intend to go deeper and get below this cloud deck."

"Deeper?" I glanced at Rodriguez, but he was saying nothing.

"Have you forgotten Fuchs? The IAA just sent word that he's descending rapidly toward the clear air below the clouds."

The prize money didn't look all that enticing to me, compared to the very strong possibility that we would all be killed if the bugs chewed away enough of the ship.

Rodriguez spoke up at last. "Mr. Humphries, we can't make an effective decision until we know how badly the gas envelope's been damaged."

"It's really very minor," Duchamp said. But then she added, "At present."

"But it's getting worse," Rodriguez said.

"Slowly," she insisted.

"As long as we stay in these clouds we're going to have colonies of Venusian organisms feasting on our ship's metals and minerals," I retorted hotly.

"This is no time to panic, Mr. Humphries," she said.

I thought it over for half a second. "I could fire you and appoint Tom captain."

"That would be tantamount to mutiny," she snapped.

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"Wait," Rodriguez said. "Wait, both of you. Before anybody goes off the deep end, let's repair the envelope and get back in proper condition."

"Do we have time for that?"

Duchamp said coldly, "May I point out that Fuchs is diving deeper while we fiddle around here. If your bugs are eating our ship, why aren't they eating his?"

"What makes you think they're not?"

"I know Lars," she said with a thin smile. "He's no fool. If he thought he was going into more danger by descending he wouldn't go down."

I glanced from her to Rodriguez to Riza, sitting wide-eyed at her comm console, then back to Duchamp.

"All right," I said finally. "I'm going back to the bio lab to help Marguerite determine if the bugs caused the damage to our suits. How long will it take you to repair the leak in the hull?"

"Several hours," Duchamp said.

"Yeats is suiting up now, with Akira. They're going to start the work from inside the shell," Rodriguez said. "It'll be safer that way."

"But they'll still be exposed to the bugs, won't they?" I asked. "I mean, if the outside air is leaking into the shell, the bugs are coming in with it."

Duchamp said flatly, "That's assuming you're right and it's the bugs that damaged your suits."

"You can't let them stay out too long," I insisted. "If the bugs do eat the suits—"

"The fabric is self-repairing," Duchamp said.

"The joints aren't," I pointed out.

There was one quick and dirty way to test whether the bugs were eating the suit material, Marguerite and I decided. I hacked off a small section of the cermet knee joint to my damaged suit to serve as an experimental guinea pig. It wasn't easy: the cermet was tough. I had to scrounge an electric saw from the ship's stores to do the job.

Then I brought it to Marguerite's lab, where she had set up a spare insulated cooler as an incubator for the Venusian organisms.

But when I brought the cermet sample to her, she was downcast.

"They're dying," Marguerite said, as miserable as if it was her own child expiring.

"But I thought—"

"I've tried to duplicate their natural environment as closely as I can," she said, as much to herself as to me. "I've kept the temperature inside the cooler just above freezing, right about where it was in the clouds. I've lowered the air pressure and even sprayed it with extra sulfuric acid. But it's not working! Every sample I take shows them weakening and dying."

I handed her the ragged little square of cermet I'd cut out. "Well, here, get this into the cooler with them and let's see what happens before they all die."

She had done a remarkable job of jury-rigging what has once been a spare cooler unit into a laboratory apparatus. The lid was sealed against air leaks, although there were half a dozen sensor wires and two small tubes going through the sealant into the cooler's interior.

All-in-all, it looked very much like the makeshift contraption that it was, the kind of thing that scientists call a kloodge. I once heard of such devices being named after someone named Rube Goldberg, but I never found out why.

Looking worried, Marguerite deftly sliced my cermet sample into hair-thin slivers with a diamond saw, then inserted half of them into the cooler through one of the tubes.

"What are you doing with a diamond saw?" I asked.

That made her smile. "What are you doing without one?" she countered.

"Huh?"

"I had hoped we'd pick up samples of Venusian rock. The saw can slice thin specimens for the microscope."

"Oh, of course," I said. I knew that; I

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simply didn't think of it at that moment.

"I would have thought," she went on, "that a planetary scientist would have this kind of equipment with him for geological investigations."

I felt my brow furrow. "Come to think of it, I believe I do."

She laughed. "I know you do, Van. I stole this from the equipment stores that you had marked for your use."

She'd been teasing me! To hide my embarrassment, I bent over and peered into the narrow little window in the cooler's lid. All I could see inside was a grayish fog.

"That's actual Venusian air inside there?" I asked.

"Yes," she replied, frowning slightly. "I was drawing it off from the main probe we've been using for the nephelometers and mass spectrometers."

I caught her accent on the past tense. "Was?"

She made an irritated huffing sound, very much like her mother. "The probes have been shut down. Captain's orders."

"Why would she. . . ?" Then I realized, "She doesn't want to run the risk of having the bugs break loose inside the ship."

"That's right," Marguerite said. "So I've got this sample and that's all. No replacements."

"And yet she acted as if she thought I was crazy when I told her the bugs ate the suits and the railing."

Marguerite shrugged as if it weren't important to her. But it was to me.

"She's a first-class hypocrite, your mother," I said, with some heat.

"She's the ship's captain," Marguerite answered stiffly. "She might think your idea's crazy, but the safety of this ship and crew is her responsibility and she's decided not to take any unnecessary risks."

I could see the logic in that. But still . . . "She's sent Yeats and Sakamoto out to repair the shell."

"That's necessary. There's no getting around it."

"Perhaps," I admitted reluctantly. "But she shouldn't let them stay out too long."

"How long is too long?"

"How long were Rodriguez and I outside? Both our suits were damaged."

Marguerite nodded. "I'm sure she's watching their readouts."

The timer on the cooler chimed, ending our conversation. Marguerite drew out a sample of the Venusian air, rich with sulfuric acid droplets and the organisms that lived in them. Quickly she prepared a microscope slide and put the display onto the screen of the laptop computer she had plugged into the electron microscope.

"They're recovering!" she said happily. "Look at how vigorously they're swimming around!"

"But where's the suit material?" I asked.

She turned from the laptop to stare at me. "It's gone. They've digested the cermet. It's food for them."

I raced along the passageway to the bridge. Duchamp was in her command chair, as usual. I could hear Yeats' voice, puffing with exertion:

". . . going a lot slower than I expected. This is tough work, let me tell you."

"You've got to bring them back inside!" I said to Duchamp. "Now! Before the bugs kill them."

Rodriguez was not on the bridge. Riza Kolodny, at the comm console, looked at me and then the captain and finally turned her face resolutely to her screens, not wishing to get involved.

Before Duchamp could reply, I said, "The bugs eat cermet. It's like caviar to them, for god's sake!"

She levelled a hard stare at me. "You have proof of this?"

"Your daughter has the proof in her lab. It's true! Now get those two people back inside here!"

Duchamp looked as if she'd prefer to slice my throat, but she touched the communications stud on her chair arm

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and said crisply, "Yeats, Sakamoto, come back inside. Now. That's an order."

"Okay by me," Yeats said, with obvious relief. She was not accustomed to much physical exertion, clearly.

"Yes, Captain," said Sakamoto, so even and unemotional that the words might just as well have come from a computer.

Duchamp called Rodriguez back to the bridge and Marguerite came up from her lab. She and I crowded the hatchway as she displayed her experiment's results on the main screen. Within minutes, Dr. Waller, Yeats and Sakamoto came up, making a real crowd in the passageway. I could feel them pressing me, pushing their sweaty bodies against me. My heart was racing; I felt queasy and breathless at the same time.

"I'm still checking air samples for the signature of the cermet materials," Marguerite was telling her mother, "but so far there is none. The organisms seem to have digested every molecule."

If this information rattled our steely-eyed captain, she did not show it. Turning to Rodriguez, she said, "What do you think?"

Rodriguez's brow was already deeply creased with worry. "We've got a catch-twenty-two situation here. We need to repair the shell or sink, but if we go outside the bugs will degrade our suits so badly we'll be at risk of total suit failure."

"You mean death," I said. "Someone could get killed."

He nodded, a little sheepishly, I thought.

Marguerite added, "Meanwhile the organisms are eating away at the shell. They could damage it to the point where . . . where . . ." She drew in her breath, realizing that if the shell failed, we would all go plunging into the depths of the atmosphere.

Is this what happened to Alex? I wondered. Was his ship devoured by these hungry alien bugs?

Then I realized that the organisms weren't alien at all. This was their natural environment. We were the aliens, the invaders. Maybe they were instinctively fighting against us, trying to drive us out of their world.

Nonsense! I told myself. They're just bugs. Microbes. They can't think. They can't act in an organized way.

I hoped.

Duchamp looked straight at me as she said, "This is what we're going to do. Each of us will take turns at repairing the shell. None of us will stay outside longer than Tom and Mr. Humphries did."

"But our suits were damaged," I objected.

"We will keep the excursions shorter than your EVA was," Duchamp said. "Short enough to get back inside before the bugs can damage the suits."

From behind me Yeats grumbled, "Then it's a race to see if we can plug the leaks faster than the bugs can eat through the shell."

Duchamp nodded. "In the meantime, I intend to go deeper."

"Deeper?" Riza blurted.

"There's a layer of clear air between this cloud deck and the next, about five kilometers below us," Duchamp said.

Rodriguez grinned humorlessly. "I get it. No clouds, no bugs."

I could feel Yeats start to object, but before she could the captain went on, "Willa, I want you to calculate the maximum time we can work in the atmosphere out there before we run into danger of suit damage."

"Yes, Captain," Yeats said glumly.

"Tom, you take the conn. Mr. Humphries and I will take the first shift. Everyone else will take a turn at the work," she hesitated a moment, looking past me. At her daughter, I supposed. "Everyone except Dr. Waller," she said.

I felt the doctor's gusting breath of appreciation on the back of my neck. He was in no physical condition for an EVA, true enough. But I worried about Marguerite; she had no training for this sort of thing. Or did she?

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Duchamp got up from her command chair. Everyone in the passageway flattened themselves out to make room for her to pass by. I followed her, fighting down the fears that were shaking me.

In a sense, of course, none of us had any training for this sort of EVA. Virtual reality simulations were all well and good, as far as they went, but nothing could prepare you for being outside in those clouds, with the wind gusting against you and the ship shuddering and bucking like a living animal. Add to that the knowledge that the bugs were chewing away on your suit. . . . it scared me down to my bladder. I felt jittery, almost lightheaded.

But it had to be done, and I wasn't going to back away from my share of the responsibility.

It wasn't easy, that's for certain. Even though we worked inside the shell, grappling along its curving bulkhead, dangling from the structural support beams by our suit tethers was far more demanding than climbing mountains.

And it was dark inside the shell. Outside, even in the clouds, there was always a yellowish-gray glow, a sullen twilight that was bright enough to see by, once your eyes adjusted to it. Inside the shell we had to work by the light of our helmet lamps, which didn't go far. Their glow was swallowed up by the yellowish haze pervading the shell's interior. It reminded me of descriptions of London fogs from long ages ago, groping along in the misty gloom.

"Riza," I heard Duchamp call over the suit radio, "get Dr. Waller to put together as many lamps as he can take from stores. We need working lights in here."

"Yes, Captain," came the comm tech's reply.

Despite everything, I had to smile inside my helmet. Duchamp wasn't allowing our ship's doctor to sit idly while the rest of us worked.

We sprayed epoxy all across the shell's enormous interior. And it was huge in there; the vast curving space seemed measureless, infinite. The darkness swallowed the pitiful light from our helmet lamps. I began to think about Jonah in the belly of the whale or Fuchida exploring the endless caverns inside Olympus Mons on Mars.

There was no way to know precisely where the leaks were: the shell wasn't instrumented for that and the leaks weren't so big that you could see daylight through them. We concentrated our spraying on the aft end of the envelope, naturally, because that's where we had seen the charring.

Duchamp and I spent an exhausting half-hour in the shell, then Rodriguez and Marguerite replaced us. Duchamp would have had the entire crew in there at once and gotten the job over with, except for the fact that we had only two epoxy sprayguns aboard.

So, two by two, the crew worked hour after hour on sealing the leaks in the gas envelope. Exhausted as I was, I took another turn, this time with Sakamoto. Rodriguez actually went out three times. So did Yeats, grumbling every inch of the way.

When my second tour was over, I half collapsed on the deck just inside the airlock, too weary even to think about peeling off my suit. I simply lifted off my helmet and sat there, not even taking off my backpack. It wasn't only the physical exertion, although just about every muscle in my body was shrieking. It was the mental strain, the knowledge that the ship was in trouble, serious trouble, and we were all in danger.

Sakamoto, standing above me, pulled his helmet off and gave me a rare smile. "Work is the curse of the drinking man," he said, then started to get out of his suit. I couldn't have been more surprised if he had sprouted wings and flown back to Earth.

Finally it was finished. I had crawled into my berth to inject an enzyme shot into my arm when the intercom blared, a scant six centimeters from my ear,

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"MR. HUMPHRIES TO THE BRIDGE, PLEASE."

Bleary-eyed, I finished the injection, then slid out of the berth and padded in my stocking feet toward the bridge, not even bothering to smooth out the wrinkles in my coveralls. Somewhere in the back of my mind I knew I was sweaty and far from sweet-smelling, but I didn't care.

Duchamp was in her command chair, as flinty as ever. Rodriguez must have been grabbing a few winks of sleep. Yeats was at the comm console.

As soon as I ducked through the hatch, Duchamp said to Yeats, "Tell him, Willa."

Looking far from jocular, Yeats said, "I have good news and bad news. Which do you want to hear first?"

"The good news," I snapped.

"We stopped the leak," she said. But her face did not show any sign of joy. "The ship is back in trim and we've broken out of the clouds into the clear air."

"We're pumping out the air we took in during the descent through the cloud deck," Duchamp added, "and replacing it with the ambient air, outside."

I nodded. "Good."

"Now the bad news," said Willa. "Every one of our suits is damaged, at least slightly. Not one of them would pass a safety inspection. They all leak."

"That means we can't go EVA?"

"Not until we repair them," Yeats said cheerlessly.

"Alright," I said. "That's not as bad as it might have been."

"The question is," Duchamp said, "will there be more bugs in the deeper cloud decks?"

"It gets awfully hot down there," I said. "More than two hundred degrees Celsius. And that's thirty or forty kilometers above the surface."

"So you don't think we'll have any problems from the bugs?"

"We should ask Marguerite. She's the biologist."

Duchamp nodded. "I've already asked her. She said she doesn't know. No one knows."

I heard myself say, "There can't be anything living at such high temperatures! It gets up to four hundred degrees and more at the surface."

"I wonder," she murmured.

From being a total skeptic about the bugs, the captain had swung to suspecting them to be lurking in the next cloud deck, waiting to devour us.

Then another thought struck me. "Where's Fuchs? Has he gone down into the second cloud deck yet?"

She nodded. "No. He appears to be hovering in this clear area, just as we are, according to the latest word from the IAA."

"I wonder if he . . ." Duchamp and the bridge wavered out of focus, as if someone had twisted a camera lens the wrong way. I put out a hand to grasp the edge of the hatchway, my knees suddenly rubbery.

I heard someone ask, "What's the matter?"

Everything was spinning madly around me. "I feel kind of woozy," I heard my own voice say.

That's the last thing I remember.

I opened my eyes to see Dr. Waller, Rodriguez and Marguerite bending over me. They all looked grim, worried.

"Do you know where you are?" Waller asked, the Jamaican lilt in his voice flattened by concern.

I looked past their intent faces and saw medical monitors, green worms crawling across their screens. I heard them beeping softly and smelled antiseptic.

"The infirmary," I said. My voice was little more than a croak.

"Good!" Dr. Waller said approvingly. "Full consciousness and awareness. That's very good."

Marguerite looked relieved. I suppose Rodriguez did too.

It didn't take much mental acumen to see that I was lying on the infirmary's

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one bed. Located back at the tail of the gondola, the infirmary was the only place on *Hesperos* with space enough for people to stand at bedside. Our bunks were nothing more than horizontal closets.

"What happened?" I asked, still not feeling strong enough to do anything but lie there on my back.

"Your anemia came up and bit you," said Dr. Waller.

I glanced at Marguerite. I had never mentioned my condition to her, but apparently Waller had told her everything while I was unconscious. She looked concerned, but not surprised. Rodriguez had known about it, of course, but he still looked very worried, his forehead wrinkled like corduroy.

"But I've been taking my shots," I said weakly.

"And engaging in more physical exertion than you have ever done in your life, I should think," said the doctor cheerily. "The hard work caught up with you."

"A few hours. . . ?"

"It was enough. More than enough."

Talk about depressing news. Here I thought I was doing my share, working alongside Rodriguez and even Duchamp, facing the same dangers and duties as the rest of the crew. And my god-cursed anemia strikes me down, shows everybody that I'm a weakling, a useless burden to them all. Father was right: I'm the runt of the litter, in every imaginable way.

I felt like crying, but I held myself together as Waller fussed around me and Rodriguez left, half-apologizing that he had to get back to the bridge.

"We're getting ready to enter the next cloud deck," he said. "We decided just to skim in and out, take some samples of the cloud droplets and see if there are any bugs in 'em."

I nodded weakly. "Good thinking."

"It was Dee's idea—Captain Duchamp's."

I turned my head slightly toward Marguerite. "It's a good thing we brought a biologist along with us," I said.

She smiled.

Rodriguez grabbed my hand and said, "You take care of yourself now, Van. Do what the doc tells you."

"Sure," I agreed. "Why not?"

He left. Marguerite remained at my bedside.

"How long will I have to stay here?" I asked Dr. Waller.

"Only a few hours, I should think," he replied, his face as somber as ever. "I'm running diagnostics on your red cell count and oxygen transfer to your vital organs. It shouldn't take very long."

I pushed myself up to a sitting position, expecting to feel my head spin. Instead, it felt fine. Marguerite hurriedly pushed up my pillows so I could sit back against them.

"You make a good nurse," I said to her. I actually felt pretty good. My voice was coming back to its normal strength.

"You scared the wits out of everyone, collapsing like that."

"How should I have collapsed?" I joked.

"Humor!" said Dr. Waller. "That's good. A certain sign of recovery."

"There's nothing really wrong with me," I said, "except this damned anemia."

"Yes, that's true. Except for the anemia you are in fine physical condition. But as Mercutio says to Romeo, 'the wound may not be as deep as a well or as wide as a church door but 'tis enough, 'twill serve.'"

Marguerite understood. "You have to be careful, Van. Your condition could become serious if you don't take proper care of yourself."

There was a part of me that was perfectly happy to be lying on a sickbed and having her looking so concerned about me. But how long would that last? I asked myself. I've got to get up and be active. I don't want pity. I want respect.

"What you're telling me," I said sharply to the doctor, "is that if I have to

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do any serious physical exertion I should take extra enzyme shots."

He nodded, but pointed out glumly, "We only have a fixed amount of the enzyme supply in our medical stores. And we do *not* have the equipment or resources to make more. Your supply is more than adequate for normal usage, with a healthy additional amount in reserve. But still—you should pace yourself more carefully than you have today, Mr. Humphries."

"Yes. Of course. Now, when can I get up and back to my work?"

He glanced at the monitors lining the infirmary's wall. "In two hours, more or less."

"Two hours," I said. "Fine."

I was actually on my feet much sooner. I had to be.

Marguerite brought me a handheld computer to work with while I sat in the infirmary bed, waiting for Dr. Waller to finish his diagnostics. He left the infirmary for a while, humming to himself as usual. I checked with IAA headquarters back in Geneva and, some twenty minutes later, got a reply that Fuchs had entered the second cloud deck more than an hour earlier.

He was ahead of us again. And apparently he had suffered no damage from the bugs that had attacked our gas envelope. Why not? Was his *Lucifer* made of different materials? Had he been damaged and then repaired his ship more quickly than we had been able to do?

Sitting there staring at the printed IAA report, I began to wonder what would happen if Fuchs actually did get to the surface first and recovered Alex's remains. He'd get Father's ten billion in prize money and I'd be penniless. Totally cut off. I couldn't even afford my home in Majorca, let alone—

The ship lurched.

I mean, *lurched*. We had bounced and shuddered when we were in the superrotation winds up higher, but once we'd sunk down to the clear region between the first and second cloud decks the air pressure had become so thick that the winds were smothered and our ride had become glassy smooth.

But now everything suddenly tilted so badly that I was nearly thrown off the bed. I clutched its edges like a child riding a coaster down a snowy hillside.

Through the closed hatch of the infirmary I could hear alarm bells blaring and the thundering slams of other hatches swinging shut automatically.

The infirmary seemed to sway. For an instant I thought I was getting dizzy again, but then I remembered that I was in the tail section of the gondola and it was the gondola itself that was swinging beneath the gas envelope. Somewhere an alarm siren started shrieking.

I jumped out of bed, glad that Waller hadn't stripped off my coveralls. The floor beneath me tilted again, this time pointing downward like an airplane starting to dive. Something behind me crashed to the floor.

"ALL HANDS STRAP IN!" the intercom blared. Great advice. I had to clutch the bed to keep from sliding down to the infirmary hatch.

The hatch swung outward and banged against the bulkhead. Dr. Waller was on the other side, his red-rimmed eyes wide with terror.

"We're sinking!" he screamed. "The gas shell has collapsed!"

For a what seemed like a century and a quarter I just hung there, clutching the bed while alarms hooted and wailed all along the gondola, staring at Waller as he held onto the hatch frame with both his hands. In the hollow of my stomach I could feel the ship dropping.

"ALL HANDS TO THE AIRLOCK," the intercom speakers blared. "GET INTO YOUR SPACESUITS. *NOW!*"

It was Duchamp's voice, sharp as a surgeon's scalpel, not panicked but certainly urgent enough to make me move.

"Come on," I said as I stumbled past Waller. He seemed frozen, mouth gap-

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ing, eyes goggling, unwilling or unable to let go of the hatch frame and start downhill toward the airlock.

I grabbed his shoulder and shook him, hard. "Come on!" I shouted at him. "You heard the captain. That means everybody!"

The ship seemed to straighten out somewhat as we staggered and weaved down the passageway. We had to manually open hatches every few meters. They automatically slammed shut behind us. At least the alarms had been silenced; their wailing was enough to scare you into cardiac fibrillation.

Rodriguez was already at the airlock, helping Riza Kolodny into her suit. The other two technicians crowded behind him, getting their own suits on.

"Where's Marguerite?" I asked him.

"I don't know. Maybe up at the bridge with her mother," he said, without looking up from his work.

"These suits are all damaged," I said, holding out the sleeve of my own. The elbow joint was obviously blackened, as if singed by a flame.

"You want to go with no suit at all?" Rodriguez snapped.

Waller moaned. I thought he was going to faint, but then I saw a growing stain across the crotch of his coveralls. The doctor had wet himself.

"What's happened?" I demanded. "What are we going to do?"

Still checking Riza's backpack, Rodriguez said, "Damned shell cracked open. We're losing buoyancy. Can't keep the ship in trim."

"So what—"

"We're going to the descent module, use it in the escape pod mode. Ride it up to orbit and hope *Truax* can find us."

"Then why do we need the suits?"

"Whole front section of the gondola's leaking like a frickin' sieve," Rodriguez said, his voice edged with fear-driven tension. "If the leaks reach the bridge before we can get everybody into the pod . . ."

He didn't have to finish the sentence. I got the picture.

I helped Dr. Waller into his suit before starting to put mine on. The ship kept dipping and then rising, making my insides feel as if I were on an elevator that couldn't make up its mind. Waller seemed almost in shock, hardly able to move his arms and legs, his eyes staring blankly, his mouth sagging open and gasping like a fish. It flashed through my mind that he had the only undamaged suit on board; all the others had developed leaks, even the spares.

By the time I got my own suit on, Marguerite and her mother were still nowhere in sight. I clomped down the slanting passageway toward the bridge.

"Where're you going?" Rodriguez yelled after me. "I gotta check you out!"

"I'll be back in a few minutes," I called back, shouting so they could hear me through the helmet. "Get everybody to the escape pod. I'll catch up with you there."

Checking out the suit was nothing more than busywork at this stage of the game. They all leaked to some degree, we all knew that. But we only needed them for the few minutes it would take to clamber into the escape pod and dog its hatch shut.

I wasn't going without Marguerite, though. What was she doing? Where was she?

Her lab was empty. The ship seemed to straighten out again; the passageway even angled upward a little, for a moment.

I pushed on to the bridge. There they were, both of them.

". . . can't stay here," Marguerite was saying, pleading really.

"Someone's got to keep the ship on as even a keel as possible," Duchamp said, her eyes fixed on the main display screen. Sitting in her command chair, she had a laptop across her knees, her fingers working the keys like a concert pianist playing a cadenza.

"But you'll—"

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I broke into their argument. "Everyone's suited up and headed for the escape pod."

Duchamp looked sharply at me. Then, with a single curt nod, she turned her gaze to her daughter. "Get into your suit. Now."

"Not until you come with me," Marguerite said.

The picture is etched in my mind. The two of them, as identical as copies from a blueprint except for their ages, glaring at each other with identical stubborn intensity.

"Both of you, get your suits on," I said, trying to sound commanding. "The others are waiting for you."

The ship lurched and heaved wildly. My stomach tried to jump into my throat. I grabbed the hatch frame for support. Marguerite, standing beside her mother, staggered and fell into Rodriguez's chair with an ungainly thump.

Duchamp turned back to the main screen, banging on the laptop's keyboard again.

"We're losing the last bit of buoyancy we have," she said, not taking her eyes off the screen. I saw that it displayed a schematic of the ship's maneuvering engines.

"Then we've got to get out!" I snapped.

"Someone's got to keep the ship from diving deeper," Duchamp said. "If I don't work the engines, we'll sink like a stone."

"What about the regular trim program?" I demanded. She barked out a single harsh, "Hah!"

I said, "The computer should be able—"

"There's no way the computer can keep this bucket on a halfway even keel without manual input," Duchamp said. "No way."

"But—"

"I'm only barely managing to hold her at altitude now."

As if to prove her words, the ship dipped down again, then popped sharply upward. I thought I could hear moaning from up forward, where the rest of the crew was waiting for us.

"It's the captain's duty," Duchamp said, glancing at me. Then she smiled thinly. "I know you didn't want me for the job, but I take the position seriously."

"You'll kill yourself!" Marguerite shrieked.

"Get her off the bridge," Duchamp said to me.

Still clinging to the rim of the hatch, I thought swiftly. "I'll make you a deal."

She arched one brow at me.

"I'll get Marguerite suited up and bring your suit here to the bridge. Then you suit up and come forward to the escape pod."

She nodded.

"Come on," I said to Marguerite.

"No," she snapped. Turning to her mother, she said, "Not without you."

Duchamp gave her a look I'd never seen on her face before. Instead of her usual stern, flint-hard stare, the captain's features softened, her eyes glistened.

"Marguerite, go with him. I'll be all right. I'm really not suicidal."

Before Marguerite could reply I grasped her wrist and literally hauled her out of the chair, off the bridge, and down the slanting passageway to the airlock where the suits were stored.

"She'll kill herself," Marguerite said in a throaty whisper, as if talking to herself. Over and over, as I helped her into her spacesuit, she repeated it. "She'll kill herself."

"I won't let her," I said, with a bravado I didn't really feel. "I'll get her into her suit and up to the escape pod if I have to carry her."

I only said it to make Marguerite feel better, and I'm certain that she knew it. But she let me help her put the suit on and check out the backpack.

I took the least-used-looking of the remaining suits and we staggered back up the passageway toward the bridge again. The ship's pitching and reeling seemed to calm down somewhat. Maybe we had

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hit a region of calm, stable air, or we were finally in equilibrium with the air pressure outside.

We got to the bridge and I offered to run the auxiliary engines while the captain got into her suit.

She gave me a pitying smile. "If I had a few days to teach you . . ."

"Then let's get Rodriguez up here," I suggested.

"I'll go get him," Marguerite said.

Raising her hand to stop her daughter, Duchamp said, "The intercom still works, dear."

"Then call him," I commanded.

She seemed to think it over for half a second, then tapped the intercom stud on her chair arm. Before she could say anything, however, the message light on the comm console flashed on.

Duchamp called out to the computer, "Answer incoming call."

Lars Fuchs' heavy, jowly face filled the screen, glowering angrily.

"I picked up your distress call," he said flatly, with no preamble.

Hesperos' command computer was programmed to beam out a distress call when safety limits were exceeded. The instant the alarms began going off and the compartment hatches were automatically shut, the computer must have started calling for help. In ten minutes or so, I realized, we would be getting inquiries from the IAA on Earth: standard safety procedure for all space flights.

"We're preparing to abandon ship," Duchamp said. "Buoyancy's gone."

"Stand by," Fuchs said, the expression on his face somewhere between annoyed and exasperated. "I'm approaching you at maximum speed. You can transfer to *Lucifer*."

Strangely, Duchamp's expression softened. "You don't have to do that, Lars."

He remained irritated. "The hell I don't. IAA regulations require any craft receiving a distress signal to render all possible assistance, remember?"

"But you can't—"

"If I don't come to your aid," he snapped, "the IAA will hang me out to dry. They'd love to make an example of me. And they won't hang me by my neck, either."

I studied his face there on the bridge's main display screen, at least two times bigger than life. There was anger there, plenty of it. Bitterness deeper than I'd ever seen before. Lars Fuchs looked like a man who'd been forced to make hard decisions all his life, iron-hard decisions that had cost him all hope for ease and joy. Joyless. That's was it. That was what made his face so different from anyone I had ever seen before. There was no trace of joy in him. Not even a glimmer that a moment of happiness would ever touch him. He had abandoned all hope of joy, long years ago.

It took all of two or three seconds for me to come to that conclusion. In that time Duchamp made her decision.

"We only have a few minutes before the gondola starts breaking up, Lars."

"Get into your suits. *Lucifer* will be within transfer range in . . ." his eyes shifted to some data screen out of camera range ". . . twelve minutes."

Duchamp drew in a deep breath, then nodded once. "All right. We'll be ready."

"I'll be there," Fuchs said grimly. Strangely, I thought I heard just a hint of softening in his voice.

Rodriguez came back to the bridge and took over the conn while Duchamp struggled into her suit. She had to step out into the passageway, there was no room on the bridge to do it. Marguerite and I both checked her out. The suit had several slow leaks in it, but should have been good for at least an hour.

"We'll be aboard *Lucifer* by then," Duchamp said from inside her helmet. We were close enough so I could see her face through the tinted bubble. She wore the same hard-edged expression she usually showed. No trace of fear or even apprehension. If any of this frightened or worried her, it certainly did not show in her face.

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"We'd better be," Marguerite said, barely loud enough for me to hear her. All our suits leaked a little, thanks to the bugs. I was grateful that we didn't have to pressurize them; Venus' atmospheric pressure at this altitude was slightly higher than Earth's.

It seemed to me that the ship's pitching and bobbing smoothed out somewhat under Rodriguez's hand, but that may have simply been my imagination—or the fact that I liked him a lot better than our hard-bitten captain.

Even so, the metal structure of the gondola began to groan and screech like a beast in pain. I stood out in the passageway and fought down the urge to scream out my own terror.

Marguerite didn't seem to be at all afraid. In fact, she knotted her brows in puzzlement. "Why are the bugs attacking just the one area of the gondola and not the entire structure?"

"What makes think they're not?" I managed to gulp out.

"The only part being damaged so far is the section between airlock and the nose area," she said.

"How can you be sure of that?"

She jabbed a gloved thumb back toward the bridge. "Look at the life-support display. That's the only section that's lost air pressure."

She was right, I saw as I peered at the life-support screen. Now I furrowed my own brows. Was there any difference between that section and the rest of the gondola? I tried to remember the schematics and blueprints I had studied long months ago, when we were building *Hesperos*.

That entire section was designed around the airlock. Maybe the bugs were chewing on the plastics that we used as sealant for the outer airlock hatch?

"Is the inner airlock hatch sealed shut?" I called in to Rodriguez, who was still in the command chair.

Without stopping to think why I asked it, he flicked his eyes to the "Christmas tree" display of lights that indicated the status of the ship's various systems. Most of the lights were bright, dangerous red now.

"No," he said, shaking his head inside his helmet.

"Seal it," I said.

"It won't do any good," Marguerite said. "If the bugs have eroded the outer hatch's sealant, they'll do the same for the inner hatch."

"It might buy us a few minutes' time," I countered.

Duchamp, fully suited up now, agreed with me. "Every second counts."

She went into the bridge and repossessed her command chair. Rodriguez came out into the passageway with us. He had to squeeze a little to get through the hatch with his suit on.

"All right," Rodriguez said. "Helmets sealed. Let's go up forward with the others."

"What about her?" Marguerite asked.

Duchamp replied, "I'm needed here. I'll leave the bridge when *Lucifer* starts taking us aboard."

"I'll stay here with you, then," Marguerite said.

"No," I said. "You're coming with us."

She had to turn her entire body toward me for me to see the flat refusal in her eyes. The same rigidly adamant expression I had seen so often on her mother's face; the same stubborn set of the jaw.

"Captain," I called out, "give the order."

"He's right, *ma petite,*" Duchamp said, in a voice softer and lower than I had ever heard from her. "You've got—"

The message light began blinking again and Duchamp stopped in mid-sentence. "Answer incoming call."

Fuchs' bleakly somber face filled the comm screen. "I'll be maneuvering beneath your ship in four minutes. I won't be able to hold station for more than a minute or so. You'll have to be prepared to jump."

"Not below us!" Duchamp cried, star-

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tled. "We're breaking up. Debris could damage you."

Fuchs glowered. "Do your suits have maneuvering propulsion units?"

"No."

"Then if you can't fly, the only way to get from *Hesperos* to *Lucifer* is to drop." His wide slash of a mouth twitched briefly in what might have been the ghost of a smile. "Like Lucifer himself, you'll have to fall."

Jump from *Hesperos* onto *Lucifer?* The idea turned my innards to water. How could we do that? How close could Fuchs bring his ship to ours? I should have added maneuvering units to the spacesuits, I never thought of it back on Earth. We weren't planning any EVA work except for the transfer from *Truax*, and we had the cable trolley for that. Rodriguez should've known that we'd need maneuvering jets in an emergency. Somebody should've thought that far ahead.

"Three minutes, ten seconds," Fuchs said. "Be prepared to jump."

The comm screen went blank.

"Come on," Rodriguez said, nudging my shoulder to point me up the passageway.

Marguerite still hesitated.

"Go with them," Duchamp commanded. "I'll hold this bucket on course for another two minutes and then come along."

"You won't do anything foolish?" Marguerite asked, in a tiny voice.

Duchamp gave her a disgusted look. "The idea that the captain goes down with his ship was a piece of male machismo. I'm not afflicted with the curse of testosterone, believe me."

Before either of them could say anything more, I put my gloved hand on Marguerite's backpack and shoved her—gently—along the passageway.

I never found out if shutting the inner airlock hatch slowed down the bugs' destruction or not. As it turned out, it didn't matter, one way or the other.

The rest of the crew, Dr. Waller and the three technicians, were up in the nose section, already inside the descent module. As far as they knew we were still planning to use the 'sphere in its escape pod mode and rocket up into orbit, to be picked up by *Truax*.

As we hurried up the passageway toward the hatch that opened onto the airlock area, Rodriguez again ordered us to seal our helmets. "Air pressure's okay on the other side of the hatch," he said, "but there's probably a lot of Venusian air mixed in with our own. You wouldn't enjoy breathing sulfuric acid fumes."

I checked my helmet seal six times in the few steps it took us to reach the closed hatch.

Meanwhile, Rodriguez used his suit radio to tell Waller and the techs to get out of the pod and into the airlock section. They asked why, of course.

"We're going to transfer to Fuchs' ship, *Lucifer*," he said.

"How?" I heard Riza Kolodny's adenoidal voice in my helmet earphones.

"You'll see," Rodriguez said, like a father who doesn't have the time to explain.

We got the hatch open and looked into the airlock section. It seemed safe enough. I couldn't see holes in the structure. But the metal seemed to be groaning again, and I could hear thin, high-pitched whistling noises, like air blowing through a lot of pinholes.

Rodriguez stepped through the hatch first, then Marguerite. I followed. The ship lurched again and I put out my hand to rest it on the sturdy metal frame of the airlock hatch, to steady myself.

Just then the hatch on the opposite end of the section swung back. Four spacesuited figures huddled there, anonymous in their bulky suits and reflective bubble helmets.

Duchamp's voice crackled in my earphones, "Fuchs is about a hundred meters below us and moving up closer. Connect your tethers to each other and start down to his ship."

Rodriguez said, "Right," then pointed at me. "You first, Mr. Humphries."

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I had to swallow several times before I could answer him, "Alright. Then Marguerite."

"Yessir," Rodriguez said.

There was no need to cycle the airlock. I just slid its inner hatch open and stepped inside, then punched the button that opened the outer hatch. Nothing happened. For a moment I just stood there like a fool, hearing the wind whistling around me, feeling trapped.

"Use the manual override!" Rodriguez said impatiently.

"Right," I answered, trying to recover some shred of dignity.

I tugged at the wheel and the outer hatch slowly, stubbornly inched open. Rodriguez handed me the first few tethers, clipped together end to end. He and Marguerite were hurriedly snapping the others onto one another.

"Attach the free end to a ladder rung," he told me.

"Right," I said again. It was the only word I could think of.

I leaned out the open airlock hatch to attach the tether and what I saw made me giddy with fright.

We were scudding along high above an endless layer of sickly yellowish clouds, billowing and undulating like a thing alive. And then the huge curving bulk of *Lucifer* slid in below us, so near that I thought we would crash together in a collision that would kill us all.

"*Lucifer* is on-station," I heard Duchamp's voice in my earphones.

Fuchs' ship seemed enormous, much bigger than ours. It was drawing nearer, slowly but noticeably closing the gap between us. Gasping for breath, I clicked the end of the tether onto the nearest ladder rung. Then I realized that Rodriguez was right behind me, feeding tether line out the hatch, past my booted feet. I watched the tether snake down toward the top of *Lucifer*'s bulbous shell, dropping like an impossibly thin line of string down, down, down and still not reaching the walkway that ran the length of the ship's gas envelope.

I suddenly realized that I hadn't taken any of my enzyme supply with me. Even if we made it to *Lucifer* I'd be without the medicine I needed to live.

Then *Hesperos* dipped drunkenly and the gondola groaned again like a man dying in agony. I happened to glance along the outer surface and saw that the metal was streaked with ugly dark smudges that ran from the nose to the airlock hatch and even beyond. I could see the thin metal skin cracking along those dark streaks.

Marguerite and Rodriguez were behind me, the four other spacesuited figures—Waller and the technicians—stood huddled on the other side of the airlock hatch. They were all waiting impatiently for me to start the descent toward *Lucifer* and safety. I stood frozen at the lip of the open hatch. Clambering down that dangling tether certainly did not look at all safe to me.

The groaning rose in pitch until it was like a screeching of fingernails on a chalkboard. I pulled my head back inside the airlock chamber, panting as if I'd run a thousand meters.

"She's breaking up!" Rodriguez yelled, so loud that I could hear him through my helmet as well as in my earphones.

Before my eyes, the front section of the gondola tore away with a horrifying grinding, ripping sound, carrying Waller and the technicians with it. They screamed, terrified high-pitched wails that shrieked in my earphones. The front end broke entirely free and flashed past my horrified eyes, tumbling end over end, spilling the spacesuited figures out into the open, empty air.

"Save meee!" one of them screamed, a shriek so strained and piercing I couldn't tell which of them uttered it.

I saw a body thump down onto *Lucifer*, below us; it missed the catwalk and slid off into oblivion, howling madly all the time.

I could hardly stand up, my knees were so watery. Rodriguez, pressed in

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behind me in the airlock, whispered, "Jesus, Mary, and Joseph."

The screams went on and on, like red-hot icepicks jammed into my ears. Even after they stopped, my head rang with their memory.

"They're dead," Rodriguez said, his voice hollow.

"All of them," said Marguerite, quavering, fighting back tears.

"And so will we be," Duchamp's voice crackled, "if we don't get down those tethers *right now*."

The ship was bucking violently now, heaving up and down in a wild pitching motion. The wind tore at us from the gaping emptiness where the nose of the gondola had been. A ridiculous thought popped into my mind: we didn't need the airlock now, we could jump out of the ship through the jagged open end of the gondola.

I could hear Rodriguez panting hard in my earphones. At least, I assumed it was Rodriguez. Marguerite was there, too, and I thought Duchamp had to be on her way down to us by now.

"Go on!" Rodriguez yelled, as if the suit radios weren't working. "Down the tether."

If I had thought about it for half a millisecond I would have been so terrified I'd have frozen up, paralyzed with fear. But there wasn't any time for that. I grabbed the tether with both gloved hands.

"The servomotors will hold you," Rodriguez said. "Loop your boots in the line to take some of the load off your arms. Like circus acrobats."

I made a clumsy try at it, but only managed to tangle the tether around one ankle. The servomotors on the backs of the gloves clamped my fingers on the line, sure enough. All I had to worry about was making a mistake and letting go of the blasted line with both hands at the same time.

Down I went, hand over hand.

It was hard work, clambering down that swaying, slithering line of connected tethers. Drenched in cold sweat, my heart hammering in my ears, I tried to clamp my boots around the line to take some of the strain off my arms but that was a clumsy failure. I inched down the line, my powered gloves clamping and unclamping slowly, like an arthritic old man's hands.

Lucifer seemed to be a thousand kilometers below me. I could see the end of the connected tethers dangling a good ten meters or more above the catwalk that ran the length of the ship's gas envelope. It looked like a hundred meters, to me. A thousand. When I got to the end of the line I'd have to jump for it.

If I made it to the end of the line.

And all the while I crawled down the length of tethers I kept hearing the terrified, agonized screams of the crewmen who fell to their deaths. My mind kept replaying that long, wailing, "Save meee!" over and over again. What would I scream if I missed the ship and plunged down into the fiery depths of inescapable death?

"Send the others down." It was Fuchs' heavy, harsh voice in my earphones. "Don't wait. Get started *now*."

"No," Marguerite said. I could sense her struggling, hear her breathing hard. "Wait . . ."

But Rodriguez said firmly, "No time for waiting. Now!"

I looked up and saw another figure start down the tethers. In the spacesuit it was impossible to see who it was, but I figured it had to be Marguerite.

She was coming down the line a lot faster than I, her boots gripping the tether expertly. Had she told me she'd done mountain climbing? I couldn't remember. Foolish thought at that particular moment.

I tried to go faster and damned near killed myself. Let go of the line with one hand, then missed my next grab for it while my other hand was opening. There's a delay built into the servomotors that control the gloves' exoskele-

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tons; you move your fingers and the motors resist a little, then kick in. My glove's fingers were opening, loosening my grip on the tether, when I desperately wanted them to tighten again.

There I was, one hand flailing free and the other letting go of my grip on the tether. If I hadn't been so scared I would've thrown up.

I lunged for the line with my free hand, caught it, and closed my fingers as fast and hard as I could. I thought I heard the servomotors whining furiously although that must have been my imagination, since I'd never heard them before through the suit and helmet.

I hung there by one hand, all my weight on that arm and shoulder, for what seemed like an hour or two. Then I clasped the tether with my other hand, took the deepest breath I'd ever made in my life, and started down the tether again.

"Where's my mother?" I heard Marguerite's fear-filled voice in my earphones.

"She's on her way," Rodriguez answered.

But when I looked up I saw only their two figures clambering down the tether. *Hesperos* was a wreck, jouncing and shuddering above us, falling apart. The gas envelope was cracked like an overcooked egg. The gondola was half gone, its front end torn away, new cracks zigzagging along its length even as I watched. The bugs from the clouds must have made a home for themselves in the ship's metal structure.

Well, I thought grimly, they'll all roast to death when she loses her last bit of buoyancy and plunges into the broiling heat below.

Then I caught a vision of *Hesperos* crashing into *Lucifer*, and wondered how long Fuchs would keep his ship hovering below us.

"Hurry it up!" he called, as if he could read my thoughts.

Marguerite was sobbing openly; I could hear her over the suit radio. Rodriguez had gone silent except for his hard panting as he worked his way down the tether. They were both getting close to me.

And Duchamp was still in the ship. On the bridge, I realized, working to hold the shattered *Hesperos* in place long enough for us to make it to safety. But what about her safety?

"Captain Duchamp," I called, surprised that my voice worked at all. "Leave the bridge and come down the safety tether. That's an order."

No response.

"Mother!" Marguerite sobbed. "Mama!"

She wasn't coming. I knew it with the certainty of religious revelation. Duchamp was staying on the bridge, fighting to hold the battered wreck of *Hesperos* in place long enough for us to make it to safety. Giving her life to save us. To save her daughter, really. I doubt that she cared a rat's hiccup for the rest of us. Maybe she had some feelings for Rodriguez. Certainly not for me.

And then I was at the end of the tether line. I dangled there, swaying giddily, my boots swinging in empty air. The broad expanse of *Lucifer*'s gas envelope still seemed an awfully long way off. A long drop.

All my weight, including the weight of my spacesuit and backpack, was hanging from my hands. I could feel the bones of my upper arms being pulled slowly, agonizingly, out of my shoulder sockets, like a man on the rack. I couldn't hang on for long.

Then I saw three spacesuited figures climbing slowly up the curving flank of the massive shell. They looked like toys, like tiny dolls, and I realized just how much bigger *Lucifer* was than *Hesperos*. Enormously bigger.

Which meant that it was also much farther away than I had first guessed. It wasn't ten meters below me; it must have been more like a hundred meters. I couldn't survive a jump that long. No one could.

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I looked up. Through my bubble helmet I saw Marguerite and Rodriguez coming down the line toward me, almost on top of me.

"What now?" I asked Rodriguez. "It's too far to jump."

Before he could answer, Fuchs' voice grated in my earphones. "I'm bringing *Lucifer* up close enough for you to reach. I can't keep her in position for long, so when I say jump, you either jump or be damned. Understand me?"

"Understood," Rodriguez said.

"Okay."

The broad back of *Lucifer* rose toward us, slowly moving closer. The three spacesuited figures were on the catwalk now, laying out long coils of tethers between them.

We were getting tantalizingly close, but each time I thought we were within a safe jumping distance *Hesperos* bobbed up or sideways and we were jerked away from *Lucifer*. My arms were blazing with pain. I could hear Rodriguez mumbling in Spanish, perhaps a prayer. More likely some choice curses.

I looked up again and saw that *Hesperos* was barely holding together. The gondola was cracked in a hundred places, the gas shell above it was missing pieces like an uncompleted jigsaw puzzle.

The only thing in our favor was that the air was thick enough down at this level to be relatively calm. Relatively. *Hesperos* was still jouncing and fluttering like a leaf in a strong breeze.

Marguerite's sobbing seemed to have stopped. I supposed that she finally understood her mother was not coming and there was nothing she could do about it. There would be plenty of time to mourn after we had saved our own necks, I thought. When your own life is on the line, as ours were, you worry about your own skin and save your sentiment for everyone else for later.

"Now!" Fuchs' command shattered my pointless musings.

I was still dangling a tremendous distance from *Lucifer*'s catwalk, my shoulders and arms screaming in agony from the strain.

"Now, dammit!" he roared. "*Jump!*"

I let go. For a dizzying instant it felt as if I hung in mid-air, not moving at all. By the time I realized I was falling I thudded down onto the curving hull of *Lucifer*'s envelope with a bang that knocked the breath out of my lungs.

I had missed the catwalk and the men waiting to help me by several meters. I felt myself sliding along the curve of the shell, my arms and legs scrabbling to find a grip, a handhold, anything to stop me from sliding off into the oblivion below. Nothing. The shell's skin was smooth as polished marble.

In my earphones I heard a sort of howling noise, a strangled wail that yowled in my ears like some primitive animal's shriek. It went on and on without letup. I couldn't hear anything else, nothing except that agonized howl.

If *Lucifer* had been as small as *Hesperos* I would have slid off the shell and plunged into the thick hot clouds kilometers beneath me. I sometimes wonder if I would have been roasted to death as I fell deeper into the blistering hot atmosphere or crushed like an eggshell by the tremendous pressure.

Instead, Fuchs' crewmen saved me. One of them jumped off the catwalk and slid on the rump of his suit to my side and grabbed me firmly. Even through the yowling noise in my earphones I could hear him grunt painfully when his tether stopped us both. Then he looped the extra tether he carried with him around my shoulders.

I was shaking so hard inside my suit that it took me three tries before I could control my legs well enough to follow Fuchs' crewman back up to the catwalk, where his companion already had his arms wrapped around Marguerite. I found out later that she had dropped neatly onto the catwalk and not even lost her balance.

I was on my hands and knees, gasping from the efforts of the last few minutes.

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My shoulders felt as if someone had ripped my arms out of them. I was beyond pain; I was numb, wooden.

The catwalk seemed to shift beneath me, tossing me onto my side. I looked up and saw *Hesperos* breaking apart, big chunks of the envelope tearing away, the gondola splitting along its length.

Marguerite screamed. I saw the line of tethers flapping wildly, empty.

Raising myself painfully to my knees, I looked for Rodriguez. He was nowhere in sight.

"Where's Rodriguez?" I demanded.

No one answered.

I looked directly at Marguerite, who had disengaged herself from the crewmen who'd held her.

"Where's Tom?" I screamed.

I couldn't see her face inside the helmet, but sensed her shaking her head. "He jumped after me . . ."

"What happened to him?" I climbed to my feet shakily.

Fuchs' voice answered in my earphones. "The third person in your party jumped too late. I had to jink the ship sideways to avoid the debris falling from *Hesperos*. He missed us and fell into the clouds."

That was the long, terrified scream I heard in my earphones: Rodriguez falling, falling all that long way down to his death.

I stayed there on my knees until two of the crewmen yanked me up roughly by the armpits of my suit. I could hardly breathe. Every muscle and tendon in my body was in agony. And Rodriguez was dead.

Marguerite sobbed, "My mother . . ." She sounded exhausted, as drained physically and emotionally as I felt.

I looked up. *Hesperos* was gone. No sign of the ship. Nothing above us but swirling sickly yellow-gray clouds. Nothing below us but more of the same.

One of the crewmen motioned me toward a hatch set into the catwalk. I nodded inside my helmet and headed for it, Marguerite following me.

Rodriguez, Captain Duchamp, Waller and the three technicians—all dead. Venus had killed them. But then I realized that was not true. It was my fault. I had brought them to this hellish world. I had made them intrude into this place where humans were never meant to be. I had killed them.

And myself, as well, I thought. Without my medication I'd be dead soon enough.

But I was still alive. Venus had tried to kill me and failed. I had survived. I still lived.

That which does not kill us makes us stronger. I remembered reading that somewhere. All right, I thought; as long as I'm still alive I'm going to push on. No matter what lies ahead, I'm going to get down to the surface of this hellish world and find what's left of my brother.

And I'm not doing it for Alex, or for the prize money, or even to prove to my father that I'm more than a Runt. I'm doing it for *me*, because I want to, because I have to.

Venus might very well kill me, in the end. But even so, I'll die trying.■

"Death on Venus" is adapted from Ben Bova's forthcoming novel, *Venus*, to be published in April 2000 by Tor Books.

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Architects of Emortality, Brian Stableford, Tor, $24.95, 319 pp. (ISBN: 0-312-87207-0).

On Blue's Waters, Gene Wolfe, Tor, $24.95, 381 pp. (ISBN: 0-312-86614-3).

Greenhouse Summer, Norman Spinrad, Tor, $24.95, 317 pp. (ISBN: 0-312-86799-9).

All Tomorrow's Parties, William Gibson, Putnam, $24.95, 278 pp. (ISBN: 0-399-14579-6).

Code of Conduct, Kristine Smith, Avon, $5.99, 346 pp. (ISBN: 0-380-80783-1).

There and Back Again by Max Merriwell, Pat Murphy, Tor, $24.95, 301 pp. (0-312-86644-5).

The Martian Race, Gregory Benford, Warner, $23.95, 352 pp. (ISBN: 0-446-52633-9).

A year ago (February 1999) I reviewed Brian Stableford's *Inherit the Earth* which described the aftermath of a solution to the population crisis. Viruses had made most humans sterile. Reproduction was now by means of artificial wombs. Lives had been much extended by nanotech IT (Internal Technology). Nanotech was also making the world a rather fluid place, with even solid, real-world items as potentially malleable as photos are today, when digital image processing now lets photos lie as easily as words.

At the time, Stableford considered the question of whether order or chaos should rule human life. Each has its points, but when reality is malleable, chaos is even more frightening than usual. In *Inherit the Earth*'s sequel, **Architects of Emortality**, he posits the MegaMall as the force that rules the planet. It is a cabal of transnational merchants whose businesses supply everyone with just about everything they buy, from shows to news. Their influence is enormous, and one might expect them to be much in favor of stability. Yet they recognize that chaos is necessary, for it sparks creativity, the engine of progress, and a constant stream of new products for the masses to buy. Of course, chaos must be managed, kept within bounds. Some is good. Too much is bad.

It's hard to argue with that. Yet many will surely do so. The principal objectors may be artists, who wish chaos and creativity to be utterly unfettered. And if evil is done in the name of creativity, why that is merely a side-effect and of no great account on the larger scale. One thinks of Baudelaire and his "Flowers of Evil" poetry, of Sherlock Holmes and his addiction to cocaine, of Oscar Wilde and his spell in Reading Gaol for homosexual offenses.

Or at least Stableford thought of such people. In *Architects*, Oscar Wilde is a genetic engineer, a designer of flowers, as affected and witty and brilliant as his namesake. Charlotte Holmes is a sergeant of UN police, working under Hal Watson. And Baudelaire's poems provide a long stream of quotations to

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accompany a series of marvelous murders.

The first of the murder victims is Gabriel King, a demolition engineer whose latest assignment is the clearance of Manhattan. He is nearly two centuries old, with no chance of further nanotech rejuvenation (the process has proved to have limits), full of fame and fortune and satisfaction. And here is a lovely young woman, *authentically* young in a world dominated by the old, who wants a tryst with him. She arrives, they kiss, and the next we know, Holmes and Watson are exclaiming over the remains: King's skeleton, entwined with gorgeous flowers.

Enter Oscar Wilde, who thinks the flowers must be the work of the genetic engineer known as Rappaccini, who specializes in funeral wreaths. Enter also Michael Lowenthal, who is monitoring events for his MegaMall masters; he is among the first of the "New Humanity," engineered for true immortality in the embryo.

More victims soon follow, all of similar age, all having been at university at the same time. There are more clues, and Wilde provides a running stream of deduction and commentary worthy of the original Holmes. *Architects* is thus a murder mystery. Readers who approach it on that level will find it a very nicely satisfying one, too. But it is also a meditation on the limits we should or should not impose on creative chaos, and those who see this will be more richly rewarded.

Highly recommended.

In his "Book of the Long Sun" trilogy, Gene Wolfe gave us a vast interstellar ark, the "Whorl," a cylinder lined with lakes and mountains and realms, peopled with millions who had long forgotten where they were, ruled by the degenerated remnants of the people who had built the Whorl and on departure moved into "Mainframe" as downloaded minds. So much was apparent to modern readers, familiar with the ideas from a mass of prior SF art. To Wolfe's characters, the Whorl was all there was, the downloaded minds were gods who visited the Whorl from time to time through Windows (computer screens), life was the usual quotidian round, religious ritual played an important part, and if the Whorl seemed to be running down, there wasn't much to be done about that. Wolfe laid out the pattern and in due time had his chief character, Silk, lead the way to liberation: The Whorl had reached its destination. New whorls awaited, and there were landers to carry people by the thousand to new lives. Like any proper prophet, Silk of course did not make the crossing. He remained behind.

What happened after? That is the meat of the "Book of the Short Sun" trilogy, which opens with On Blue's Waters. Here is Horn, narrator of the earlier books, now telling his own tale. He and his wife Nettle, papermakers, are visited by dignitaries from New Viron who insist that the New Whorl, known as Blue, needs Silk. Will Horn undertake a journey to Pajarocu, where a lander has reportedly been readied for a return to the Old Whorl, return, find Silk, and bring him back? It is hardly possible to say no, and off Horn goes, to encounter the few remaining natives of Blue, their Mother goddess, a one-armed maiden named Seawrack, and a great deal more besides.

We know from the start that he never finds Silk, for he speaks often of his failure from his vantage as the Rajan of Gaon, a prisoner of his skill at mimicking Silk in the resolution of disputes. We also know something of his adventures, for he also mentions visiting—presumably via that lander—the hell that is Green, Blue's neighbor. But his attention wanders from the memories he is recording to Gaon's present, his many wives, his duties, and the war that threatens everything he has come to hold dear.

The result is a tapestry of memory and present and allusion to what is yet offstage, all woven together to feel so

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real that anyone who gets far into this volume will find it impossible to resist the next, *In Green's Jungles*.

It's been awhile since Norman Spinrad's last (*Pictures at 11*, reviewed here in July 1995), so I'm delighted to say he's back. The new book, **Greenhouse Summer**, posits a time not too far in the future when the greenhouse effect and global warming are significant. Sea level has risen, there is a dike around Manhattan, and low-lying areas such as New Orleans are gone. The tropics are practically uninhabitable. Paris is a paradise of palm trees and bougainvillea; toucans perch on the Tuilleries; and the tourists are wowed by the Lost Louisianne chic of crawfish gumbo and steamboat cruises on the Seine. Capitalism is passé, nations and corporations replaced by syndics such as Bread & Circuses, which will sell any project, be it well or ill advised, and Bad Boys, derived from the old mafias and tongs, which peddles drugs and other sins. And the world is polarized into the Blues (named for the ocean waters that have covered many homelands) and the Greens (named for the tropical foliage that has enlivened many once chilly lands).

Meet Monique Calhoun, Bread & Circuses up-and-comer, dispatched to Paris to handle the VIPs at the latest UN climatological conference. The big question is whether Earth is about to go the way of Venus, but the forecasts are unreliable and the powers that be have been talking this to death for years, always before in very Blue, third-world venues. But this one's in Paris, and the impoverished UN is throwing money around like mad. Something is clearly up, and the Big Blue Machine, the consortium of remnant corporations that sells climate-fixing projects, seems to be behind it.

Meet "Prince" Eric Esterhazy, narcissistic buffoon and front man for the luxe casino riverboat *Reine de la Seine*. He's a Bad Boys boy, and when Monique shows up wanting to rent the boat for her VIPs, the sparks begin to fly. The boat, you see, is wired stem to stern to eavesdrop on the rich and famous; it's a data sieve, and Bad Boys *never* rents it out. Except they do this time, Monique and Eric get it on, and it soon emerges that the worst word on climate catastrophe is fakery.

Should the Bad Boys queer the pitch (for money, of course)? It's a real question, for Spinrad assures us that syndics, even those derived from organized crime, do not do things just for money. They have a genuine moral code, and if Big Blue is faking the evidence to provoke action that really will save the world, they have to go along. If Big Blue is just in it for the money, on the other hand, screw 'em.

It takes a little while to get used to Spinrad's idiosyncratic prose style, but it's worth the effort. This one's thoughtful, thought-provoking, and fun.

William Gibson's **All Tomorrow's Parties** is the sequel to both *Virtual Light* (reviewed here in January 1994) and *Idoru* (March 1997). Once more we meet Laney, the man who, thanks to childhood exposure to a certain experimental drug, can see "nodal points" in the vast skeins of data that flood the Net. He is now living in a cardboard box in a Tokyo subway station, dodging sleep with over-the-counter concoctions, plugged in, sensing a massive node taking shape in San Francisco. Soon, something momentous will happen, something that will change the world; a zillionaire named Cody Harwood is involved, so is a mysterious figure visible only by his absence from the data, and Laney is worried. He needs a man on the ground, and who else should that be but ex-cop and TV-star-wannabe Berry Rydell, who is now working security in a Los Angeles Lucky Dragon (a globally ubiquitous convenience-store chain controlled in major part by Cody Harwood)?

When Rydell reaches San Francisco,

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he goes to a local Lucky Dragon to pick up his retainer and a package, a mysterious metal cylinder, and then to the Golden Gate Bridge, still encrusted with super-glued shanties (remember *Virtual Light*), where he visits a certain store to pick up a pair of cables. When he plugs the power cable into the cylinder later on, in his tiny rental room, he is surprised by Rei Toei, the idoru, software construct, artificially intelligent, to all appearances a person even if she is a hologram. She would love to be real—solid-real, not just info-real.

Meanwhile, Chevette Washington, once Rydell's girl, is fleeing a bad relationship and returning to San Francisco. Silencio, young hanger-on to a couple of drug-addict thugs, survives their encounter with a mysterious knife wielder and discovers a fascination with watches. Nanotech matter-faxes—which depend utterly on the ability to reduce matter to information, and then to convert information back to matter—are being installed in Lucky Dragon outlets all over the world. They are *not* supposed to be able to send people, but. . . .

And the heavies are converging on Rydell and his cylinder, ready to burn the entire Bridge community down to be sure of getting him.

All ends well for Rei, Rydell, Chevette, Silencio, and others, but for none quite so well as for the reader. This one is a magnificent ending for a trilogy that puts most others in the shade.

In **Code of Conduct**, Kristine Smith creates an intriguing world. Years before the time of the story, a diplomatic team, sent to establish peaceful relations with the idomeni, got involved. Several of its members went to the alien university and held their own in rigorous training. Then they got involved in a war, and Captain Jani Killian was nearly killed by a bomb planted in her transport. Indeed, she survived only because of the ministrations of a team of doctors who were most interested in pushing the limits of their restorative techniques. Fortunately, this meant that they kept her away from the authorities who would eagerly have executed her for shooting her commanding officer (having caught him involved in nefarious doings).

She thus lived long enough to run and hide and make a living on the fringes as a documents technician (an intriguing profession: Smith posits that paper will survive, for security features can be embedded in it just as they are in today's currency; among other things, doc techs are concerned with authenticity) while the authorities continue to hunt for her. One day, Evan Van Reuter, an old lover from the idomeni days, finds her. He wants to fetch her back to civilization, where he is a cabinet minister. Her job will be to analyze the circumstances of the death of Evan's wife. She will also be right under the nose of those who want her hide, and her idomeni mentor, ambassador Tsecha, who once had an exceedingly high opinion of her and who cannot fail to recognize her, will be nearby.

Smith weaves a tangled web of intrigue, of plot and scheme and conspiracy, and in the end extracts a resolution that satisfies the reader, at least temporarily. I say "temporarily" because Smith is clearly leaving room for a sequel, and it looks to be well worth some anticipation.

It's not the first time a book has put a "by X by Y" byline on the cover, for Gene Wolfe did it in 1991 with *Pandora by Holly Hollander*. But Pat Murphy's **There and Back Again by Max Merriwell** may command a much greater readership, and not just because she did a very nice job of telling her tale. She did, but the novel gains considerable appeal by being a space opera version of J. R. R. Tolkien's *The Hobbit*.

Here, the hobbits are norbits, residents of the Asteroid Belt who live in hollowed-out rocks, operate mines, and garden happily in their greenhouses. Norbit Bailey Beldon is a happy norbit,

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very much the homebody, but one day Gandalf—er, Gitana, a quite legendary adventuring lady—shows up with a train of Farrs in her wake. The Farrs are a clone of travelers and treasure-seekers, and here are Poppy and Jasmine, Heather and Iris, Lily and Lotus, and finally Zahara. Bailey bows and bobs and answers each "At your service" with an "At yours and your family's." His guests then lick the pantry clean, break out the booze, examine the artifact of the Old Ones that points the way to a vast treasure, consider whether Bailey should join the expedition "for balance" (Gitana insists!), and when Bailey wakes, he is aboard ship, well and truly embarked on the adventure of a lifetime. In due course, he will encounter a cyborg Gollum and acquire a magical ring (another Old Ones artifact), and he and his talents will prove as useful to the Farrs as ever did Bilbo's to the dwarves, and of course in much the same way.

There and Back Again is quite deliberate and unabashed space opera, and it has all the faults of that venerable genre. Space is crowded with asteroids and pirates and monsters (including the giant spiders of the Great Rift Cloud, as well as the final dragon). Our Heroes are in constant trouble, and they reliably squeeze through to triumph in the end. The plot is even more familiar because of its dependence on a famous model, but Murphy has done such a marvelous job of translation that part of the charm of this one lies in recognizing the parallels.

Finally, Murphy promises to go "by X by Y" one better. We will soon see *The Wild Angel* by Mary Maxwell by Max Merriwell by Pat Murphy (Mary is one of Max's pen names, you see). Still later will come *Adventures in Time and Space with Max Merriwell*, "in which Max deals with the shifting nature of reality and identity."

It rather sounds like Murphy is having fun. She's also inviting us all along for the ride, and I don't think those who accept the invitation will regret it.

* * *

I'm writing this at the end of August. On December 3, 1999, NASA's Mars Polar Lander is scheduled to land on Mars and study the polar ice, which may someday help support Martian explorers. Over the next decade, several more missions are scheduled, and while no one is willing to schedule a manned mission now, the right and proper culmination of the effort is of course precisely that.

Who will do it? Who else but NASA? Unless, that is, something happens. In **The Martian Race**, scheduled for publication to coincide with the Polar Lander landing, Gregory Benford posits that that "something" will be a *Challenger*-type explosion, and that Congress will promptly say to Hell with Mars, decide space is too hazardous, and declare all the megabucks should be spent right here at home. We've heard enough such talk to make this quite believable.

But NASA is hardly alone in the world. Right now there are Robert Zubrin, the Mars Underground, the Planetary Society, and the Mars Society, all eager to go and busily figuring out how to do it on the cheap. When NASA falters, says Benford, billionaire John Axelrod will step forward to use all that figuring to organize and promote and market like mad a private effort starring Marsnauts Julia and Victor (married), Marc, and Raoul. The plan is to make the trip, do the science, come home, and win the UN's $30 billion Mars Prize. Unfortunately, a Chinese-German "Airbus" team also has its eye on the prize, and they plan to fly a faster rocket.

One of the difficulties with which NASA must deal is the political demand for perfect safety. It isn't possible, but to try for it requires multiple redundant backup systems. "On the cheap" means fewer such systems and the acceptance of more risk. It is thus very gratifying that Julia *et al.* make it all the way to Mars. Unfortunately, they're counting on using the return vehicle in place for

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NASA's failed mission, and it turns out to be damaged. Can they fix it? They can try, but....

Everything else works fine. They collect rocks, they find ancient fossils, they keep in touch with home, and they stay up-to-date on the Airbus team's progress, as well as its refusal to consider rescuing any stranded Marsnauts. A small repair kit, that they can deliver, but....

As the launch-for-home date nears, Julia and Victor discover an active volcanic vent with suspicious-looking slime on its lip. Is it alive? Hard to tell, for even if it was when it was safe in the warm, moist depths of the planet, the rigors of the surface would destroy it. They start down the hole, Victor sprains his ankle, and they must return to base. Julia immediately pushes for a return to the vent, but other matters get in the way.

Benford does his best to maintain the suspense, but there have been so many Mars novels lately that one fairly easily predicts the major events, at least in outline. It's mostly the details that remain for the reader to learn, and there can't be too many surprises in details. Still, it's an enjoyable read. Benford hews quite close to the truth as we know it, and the result is a far voyage that might truly someday be.

Biolog: Ramona Louise Wheeler
Continued from page 66

ics, mythology, hieroglyphics, biology, and sundry other fields useful to a budding SF writer.

At a Boston *Star Trek* convention, she met future *Analog* writer Sherry Briggs, and both signed up with Hal Clement's SF writers' group. He introduced her to the golden classics of SF, written by such masters as Jack Williamson. Concentrating on the story lines instead of the language, she caught up with the field and would be able to avoid reinventing SF wheels, something often done by "outsiders" who think they have a new idea.

Ramona is a person of great enthusiasms, and pours herself into whatever she is doing at the moment. SF cons are like boxes of bonbons, where she can sample interesting, intelligent people. Stan Schmidt was one, who told her he didn't have any limit on submissions. She then sent fifteen stories totaling 175,000 words in three weeks. Snoopy said he liked to hear editors beg when one pleaded with him to stop sending stories. Stan called a sanity-restoring moratorium based on a little-known law of this physicist known as "The Schmidt Limit." Ramona says this is 50,000 words a week per author.

The band has become increasingly popular. Heavy gigs in Beatleland last summer had Brits referring to "The Liverpool Band from Boston." The same summer saw first, second, and third sales to *Analog*. Writing instructors had passed on the ancient wisdom of writing about what you know. This can be difficult in SF, considering interstellar travel, time paradoxes, and ET sentients. Ramona progressed on her own to the notion adopted by many SF writers: "Write the stuff you like to read." This turns out to be what Stan Schmidt likes to read, too.

Ramona's book *Walk Like an Egyptian: A Modern Guide to the Religion and Philosophy of Ancient Egypt* is being published by Allisone Press in Mount Shasta, California, *<http://www.allisonepress.com>*.

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BRASS TACKS

Dr. Schmidt,

Just a quick note of congratulations for the October 1999 editorial "Initial Conditions." I thought it was well done and expressed my feelings exactly. Your point about making reparations to those long deceased and by we who had nothing to do with it is well taken.

DENNIS D. GAUNT

Dear Dr. Schmidt,

Fundamental disagreement with you this time over "Initial Conditions." The descendants of those who wronged someone else most certainly *do* owe reparations to the descendants of those who were wronged, in the sense that those who are forced to start with little and face longer odds deserve at least a level playing field against those who gained their power and advantage through unethical acts. It is well known that under today's tax and legal structures almost everywhere in the world, that the rich grow richer and the working poor grow more numerous and relatively poorer. It is patently unfair for a multi-millionaire CEO to be sitting back in his easy chair, voting himself a pay raise while whining about the cost of minimum wage, while the young adults who never *had* a chance to go to college work sixteen-hour days at two or three jobs for barely enough to feed their families.

Level the playing field. Start all children out with an equal chance at good nutrition, health care, parental guidance, and education, and see how many of those millionaire kids make it against the competition. . . . Common sense does *not* take a chessboard when one side has a surviving Bishop, Knight, Rook, and Queen, and the other side has only pawns.

DIAN HARDISON

A "level playing field" is a lovely ideal, but just what can we do to achieve it? Practical suggestions from any quarter are welcome—but that problem isn't simple, either, and any attempts to do this have to deal with other ethical considerations, too. (I made one suggestion in my August 1984 editorial "Heirs Unapparent," but that evoked plenty of howls of outrage, too—and while it would do quite a bit, even it couldn't provide a really *level playing field.)*

Stan:

Once again, you're trying to be profound. The editorial, "Initial Conditions," seems to me to be one of those things that are a foregone conclusion.

Of course, there should be a statute of limitations. Even for genocide.

But . . . the details, ah, the details. When is an injury "irremediable?" How can justice be approximated, how can one take from Peter to pay Paul when the original offense was committed by their grandfathers?

I'm sure that there will be a lot of debate, and a lot of simple answers will be forthcoming . . . none of which will really serve. There is no substitute for intelligence, Solomon will not be replaced by a rule book.

In my cynical view, the only reason we struggle with some of these cases is that we have nothing better to do. The liberation of humanity from the need for productive work lets us devote our energies to all sorts of trivial pursuits.

WARREN RAYLE

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Dear Stan:

I suspect you're going to get a lot of responses to your October '99 editorial, but I want to have my own say, anyway. Usually I agree with most of what you say, and only object to one or two relatively minor points, but in this case I disagree strongly with almost all of your editorial.

While it's true that the descendants of people who robbed or cheated others out of their property are not responsible for those deeds, they are nevertheless the beneficiaries of those illegal actions, just as the descendants of those who had their property illegally taken from them are also victims. It's also true that while the original owners *may* have squandered or otherwise lost their valuables, that is hypothetical and irrelevant. I'm actually rather surprised that you used such poor logic as to claim that some hypothetical subsequent action justifies the *actual* illegal activity.

Taken as a whole, your editorial is tantamount to justifying and promoting "might makes right," a philosophy more suited to a barbaric rather than a civilized people. To my mind at least, civilization includes reliance on law, which in turn rests on concepts of justice and fair play. While not perfect, our system of justice, fair play, and American jurisprudence (and international law, largely) tell us that property obtained through force or guile from someone who parted with it unwillingly is to be returned to its rightful owner. If the rightful owner is an heir of the original owner, and the current possessor is someone who merely *thinks* he owns it, it is surely an unfortunate situation, but one that gives the possessor no more rights than the original thief, even though he is not responsible for the theft. An argument could also be made that the current possessor should have made inquiries into the history of the property, to find out whether it was in fact, fairly and legally acquired by its previous owner in the first place.

I am also surprised at your use of such flawed logic in using the situation you describe (from "Squatter's Rights") as support for your position. The rights of (a) people to reclaim property that they abandoned willingly can be (and would have to be) debated on its own merits, but that has little or nothing to do with the right of people to reclaim property that was taken from them, or their ancestors, unwillingly through force or guile.

The main problem in these cases is to determine who the rightful owner of a given piece of property is, but that is a practical problem, and has no bearing on the philosophical question of what should be done with the property.

HOWARD MARK

But it's not a simple or easy problem, and as time goes on, it rapidly becomes an essentially impossible one. I explicitly acknowledged that there are cases (generally soon after the event) in which a rightful owner can be identified and reparations can and should be made, but that becomes increasingly impossible as generations pass. Your assumption that property would have continued to be passed down from generation to generation is not one whit less hypothetical than my assumption that it might not, and you use it to justify theft from present owners who have committed no theft—which is also an "actual illegal activity."

And what I said is not even remotely tantamount to "might makes right"! That would imply that if you *steal something, you are entitled to keep it, which I agree is completely untenable for a civilized society. My point was that you should not be penalized for something* your long-dead ancestor *did to somebody else's long-dead ancestor. That's* entirely *different.*

Dear Stan:

Your editorial in October 1999 was simplistic and, quite simply, more often wrong than right. We can't change the past, true, and we can't always make

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reparations for it—in fact, not all demands for reparations are of equal worth—but that doesn't mean injustices suffered in the past have no bearing today.

You refused to be specific (though the story you referred to seemed to have obvious similarities to modern Israel), but Native treaties here in North America are a very good example of how wrong you are. First, the government (Canada or US) would encounter a people and then they would "treaty" with them, establishing territory and rights. Almost always this happened before there were great numbers of white settlers. Second, settlers would come and establish themselves there. They would use the land and resources as they saw fit, and counter any Native resistance with violence. This was done with the support of the government. Often it was the government itself, army and/or police, that carried out the suppression, and it was the government who recognized the settlers' property claims.

Should they receive reparations? Treaties were not signed between individuals, but governments, Native councils and legislative bodies, who represented their nations. Those nations still exist and the treaties between them are still legal documents. But, some argue, they were made generations ago and don't have any bearing on us today. So were our constitutions, should they be rewritten with each generation? Don't we as nations continue for more than one generation? And these actions still continue to have a bearing on the peoples who have had their lands and rights forcibly taken from them. Many are reduced to handouts when once they owned everything.

But its not theirs now? No, and they didn't give it away. It was taken from them and if possession can justify ownership, then who can complain if a court gives them back possession?

Well, this is only one example—the return of the Jews to Palestine is another—but it's arrogant to sit in the comfort of a stable and prosperous country and tell those who have been dispossessed to let bygones be bygones. You can't generalize, as you have tried to, but must weigh each case on its merits and act appropriately.

DAVID BIRD

I refused to be specific (as I explicitly stated) because my concern was not with specific cases but with general principles. One of those was that when you use such terms as "they," you must be clear and consistent and very careful about exactly whom they apply to. In your letter, for example, "they" and "them" oscillate freely between two quite different meanings—and the difference is crucial!

Dear Dr. Schmidt,

I really appreciated your October editorial, "Initial Conditions." While I gather your article was written for American conditions, it applies here also—politically incorrect though it may be.

I have often been bemused by the media barons' insistence that I, as an Australian individual, should go around beating myself, and muttering "mea culpa." Why? Because some folk with white skins had allegedly been involved in a brouhaha with some folk with black skins.

It seems especially silly since I'm the first of my people to settle here—and, if family history is to be believed, I'm part Moriori.

I just know I'll be tarred and feathered, then run out of town on a rail for this, but to those getting bent out of shape over this I say, "It happened. It's over. Live with it."

On a much lighter note, kudos to William Walling on a particularly lucid explanation of the Global Positioning System and its applications. A nice piece of science writing for the non-specialists among us.

EUAN MILLER

Dear Stan,

I have just read your October '99 edi-

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torial, and I generally agree with you. However, there is a complicating factor there: the right to inheritance. Most people agree that it is just and reasonable for us to leave the result of our work to our children when we die. As a consequence, if my ancestor was robbed, I was also robbed because I didn't receive what would have been mine by inheritance. Since inheritance is recursive, that is, I can leave to my descendants what I inherited from my ancestors, it follows by induction that I can claim reparations for any grievances suffered by any of my known ancestors, no matter how far removed. In order to let people forget about past conflicts, perhaps the following law should be enacted: you only have the right to leave to your descendants what you earned as a result of your own effort. When someone dies, all that he received as inheritance from his ancestors should be deducted (in the form of taxes to the government) from what he left to his descendants. In this way, someone could die a millionaire and still leave nothing to his children if he let his inherited fortune shrink during his lifetime. This law would have three benefits: 1) allow a general reduction of other taxes; 2) create an incentive for an active and productive life, even from rich heirs; and 3) let people forget past grievances.

Valter M. Hilden
vhilden@infolink.com.br

Dear Dr. Schmidt,

While I find myself agreeing (as I usually do) with the conclusions in your editorial, "Initial Conditions," I do disagree with its "self-evident" premise: "You are not responsible for what your great^n-grandparents did to mine, and I am not responsible for what my great^n-grandparents did to yours." The presumption that one cannot inherit obligation or responsibility is the philosophical child of John Locke's "Man in the State of Nature"—one who is morally autonomous, having no debt or responsibility to any other person, bound to others only by the need to fairly carry out anything one has freely contracted to. If I were taken at birth and placed far from any human contact, I might claim this status (ignoring the trivial gift of genes and nine months' free ride in the womb). Well, actually, I would almost certainly be dead; or if I were found and reared by some kindly she-wolf, something not at all human. The rest of us are bound in an enormously complex web of obligation that we translate roughly as heritage or inheritance. We inherit from our parents not merely their final estate, but all that they have taught (for good and for bad) in their support when we were most vulnerable and in the communities they have embedded us in childhood and in the network of contacts they have helped us to build. While we became what we are by wrestling with, adapting, and building on our heritage, we did not have the choice of only inheriting the "good parts." Next, we inherit the society, economy, technology, and aesthetic we grow up with. The greatest geniuses of earlier ages were not smart enough to surround themselves with computers, spaceships, modern medicine, or *Gilligan's Island* reruns. A child born of illiterate parents in a Bengali hovel is not likely to gain an American suburban heritage, regardless of personal virtue or ability. How, in all this network of inheritances, distributed among us in such enormously unequal measure, can we claim that one element alone—that of obligations arising from past injustices—is not heritable? There is a peculiarly unpleasant odor that one gets in encountering all those sanctimonious nineteenth-century New Englanders who denounced Southern slavery while basking in a regional prosperity (and often great family fortunes) created in large part by slavetrading grandfathers (you will search in vain for any suggestion from any of them that their own ill-inherited wealth might be drawn upon to help eliminate the injustice). Today German descendants of Nazi murderers rightly claim that they were not them-

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selves complicit—yet nothing can change the fact that they exist, while the descendants of the victims do not. If we admit all of this, however, there is still a strong case to be made against the notion of generational reparations. To begin with, we are the inheritors of many traditions simultaneously, and often the effect is that we are all heirs of different outcomes from different injustices. Few things were sillier in the last generation of radicalism than watching groups of white women and of black men accusing each other of oppression. As Americans, many of us were taught to be aggrieved at Japanese perfidy at Pearl Harbor and bestiality in the treatment of American POWs; the Japanese feel as strongly wronged at our internment of them in concentration camps and, of course, the use of nuclear weapons on Japanese cities. Palestinians believe they were unjustly ousted from their homeland fifty years ago by Jews who believe the same thing happened to them nearly 2,000 years ago. Of course, once we accept 2,000 years as the statute of limitations on injustice, pretty much every culture in the world can get into the act. After all, it is less than 1,000 years ago that the ancestors of English and American WASPs were brutally enslaved by the Normans. We would end up turning the whole world into Yugoslavia, where no one ever learns and no one ever forgets. Another compelling reason for leaving behind the notion of generational debts is bound up in our psychological development. It is difficult, I am told, to bring up a black child in America today. One wishes to prepare one's child for incidents of racial bigotry, which often seem to come in the most unexpected times and places, to protect and insulate them from shock. Yet nothing is more universally true among children than an uncanny ability to detect when adult authority can be divided and consequences avoided; if a teacher's authority in the classroom can be undermined in this way, the child will not learn to full potential. Further, if children come to believe, from parents, peer group or culture, that they are "owed" reparations, rather than having to struggle to the limits of their ability to achieve (which they may be told is useless in any case), they will grow up profoundly crippled. So I seem to come to the same conclusion in practice that you do, if from a different basis. The real problem seems to be, not the legitimacy of generational debts, but rather the inevitable changes that come over us as human beings when we try to cash in on those debts.

GARY W. BENNETT

Analog,

I have just finished my first issue of *Analog*. I am very pleased with the content.

Specifically, I would pass along a "well done" to Ramona Louise Wheeler for "That Sleeper In The Heart." Excellent story. I hope there are more adventures of Ray and Rokey in the works!

TURNER MORGAN

Dear Mr. Nordley:

Water-tuned musical glasses would be tuned to an external pitch reference standard. A slightly higher level of H_2O than D_2O would be required; whether this would make a detectable difference in timbre or not, I couldn't guess. Try it and see (or rather, hear)! Liquids of greatly different densities (a light hydrocarbon like hexane versus one of the dense liquids used in gemology to identify gemstones by flotation) would make a greater difference. See *Fundamentals of Musical Acoustics* by Arthur Benade, page 301, example 3, for difficulties in analyzing the pitch of this type of instrument.

STUART-MORGAN VANCE

Please reread Mr. Nordley's letter carefully. He was talking about duplicating *the water instrument in the nanotechnological way described in his story, that is, atom by atom. So it would* not *be tuned to an external pitch standard.* ■

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UPCOMING EVENTS Anthony Lewis

22-26 March 2000
21ST INTERNATIONAL CONFERENCE ON THE FANTASTIC IN THE ARTS (academic SF conference) at Fort Lauderdale, Hilton Fort Lauderdale, FL. Guest of Honor—Octavia Butler; Special Guest—Nancy Kress. Registration—$75 until 1 January 2000, $90 at the door. Info—IAFA, Florida Atlantic University, College of Humanities, HU-50, B-9, 500 NW 20th, Boca Raton, FL 33431. URL—<ebbs.english.vt.edu/iafa>

24-26 March 2000
LUNACON 2000 (New York City area SF conference) at Rye Town Hilton, Rye Brook, NY. Guest of Honor—George Alec Effinger; Fan Guest of Honor—Stu Schiffman; Special Guest—Barbara Hambly. Registration—$36 until 25 February 2000, $45 at the door. Info—Lunacon 2000, PO Box 3566, New York, NY 10008-3566. email—<lunacon@lunacon.org> URL—<www.lunacon.org>

24-26 March 2000
MILLENNICON-1 (Ohio area SF conference) at King's Island Resort and Conference Center, King's Island (Cincinnati), OH. Guest of Honor—Connie Willis. Registration—$25 until 28 February 2000; $30 at the door; $20 one-day memberships (any day). Info—MILLENNICON, 143 Schloss Lane, Dayton, OH 45418. Phone—(513) 933-0452; Fax—(513) 932-1957 (Call before faxing). email—<millennicon@mvfl.org> URL—<http://www.millennicon.org>

31 March-2 April 2000
5CON (5-college area SF conference) at Seelye Hall, Smith College, Northampton, MA. Registration—$15 until 15 February 2000; $25 at the door; Friday 5PM-9PM: $10; Saturday 9AM-1AM: $15; Sunday 9AM-4PM: $10. Info—5CON, 98 Green St. Box 8758, Northampton, MA 01063. email—<viktorie@javanet.com> URL—<http://sophia.smith.edu/ssffs/5con/>

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31 August-4 September 2000
CHICON 2000 (58th World Science Fiction Convention) at Hyatt Regency, Chicago, IL. Guests of Honor—Ben Bova (former editor of *Analog*), Bob Eggleton, Jim Baen, Bob & Ann Passovoy; TM—Harry Turtledove. Registration—$150; supporting $40. [These rates are good as of 1 October 1999; they may go up again. They are the latest posted rates as of the time this column went to press.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Chicon 2000, Box 642057, Chicago, IL 60664. email—<info@chicon.org> URL—<www.chicon.org/>

26-29 October 2000
WORLD FANTASY CONVENTION 26 at Omni Bayfront, Corpus Christi, TX. Guests of Honor—K. W. Jeter, John Crowley; TM—Joe Lansdale. Registration—$90 until 7 November 1999, then more. Info—WFC 2000, Box 27277, Austin, TX 78755. email—<fduartejr@aol.com> ■

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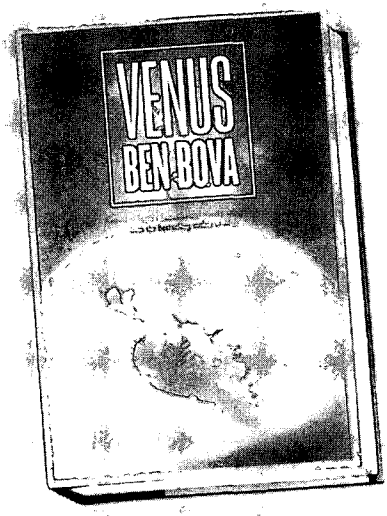

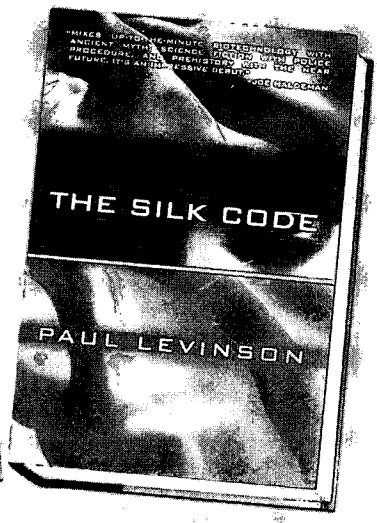

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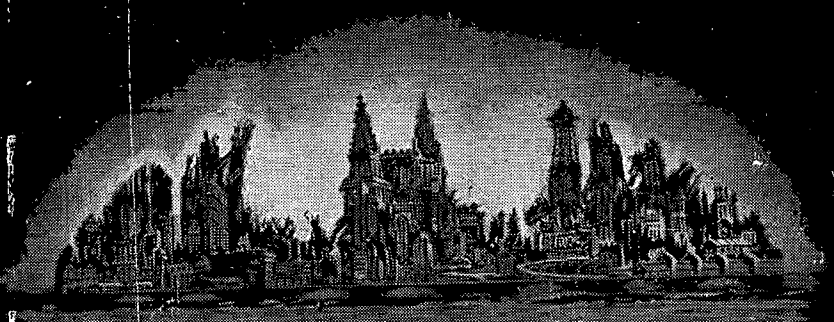

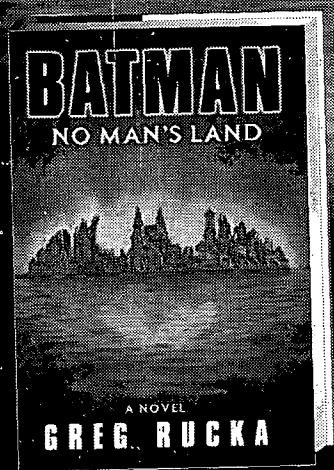

Leveled by a massive earthquake, Gotham City has been completely cut off from outside aid, transformed into a lawless battleground—a No Man's Land. In the midst of the chaos, dedicated Police Commissioner James Gordon and Batman must overcome their differences to reclaim the city.

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